INSTRUCTION MANUAL

# Variac®
# Automatic Voltage Regulators

Types 1571-A, 1581-A, 1582-A #508

1571-A, 1581-A, 1582-A

1571-A, 1581-A, 1582-A

GENERAL RADIO COMPANY

B

INSTRUCTION MANUAL

# Variac®
# Automatic Voltage Regulators

## Types 1571-A, 1581-A, 1582-A

Form 1571-0100-B
April, 1967

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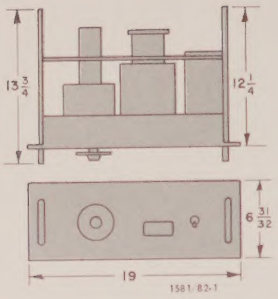
TYPE 1571-AL, -AH

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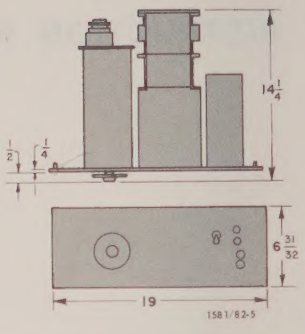
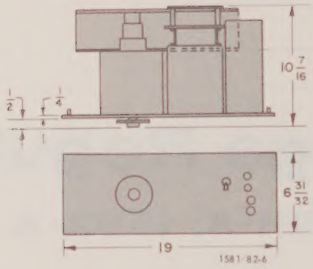
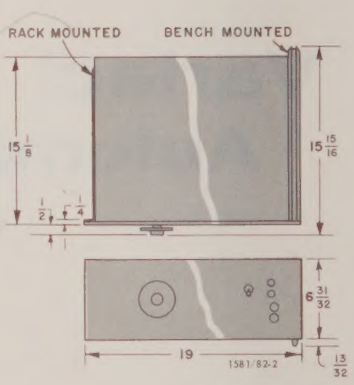


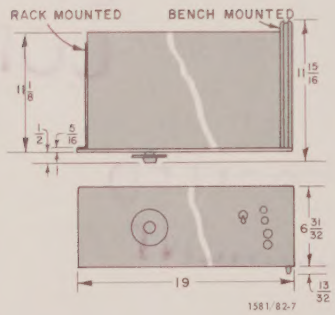

TYPE 1581-AL, AH

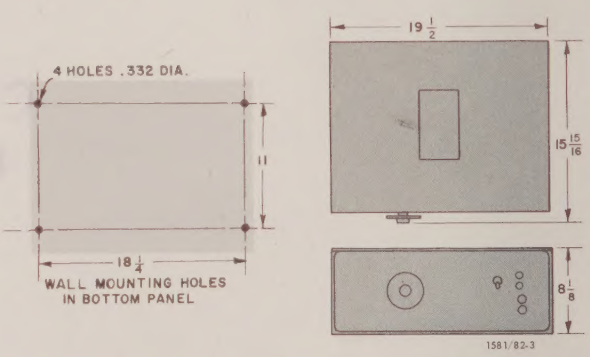



TYPE 1582-ALM, -ALR
TYPE 1582-AHM, -AHR

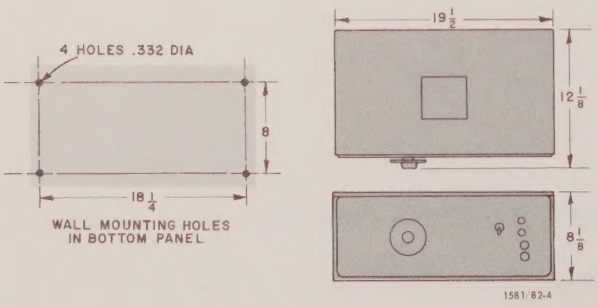



TYPE 1581-ALM, -ALR
TYPE 1581-AHM, -AHR




TYPE 1582-ALW, -AHW




TYPE 1581-ALW, -AHW

DIMENSIONS ARE IN INCHES

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# SPECIFICATIONS

## TYPE 1571-A

**Output Voltage:** Adjustable over a range of ±10% from a base value of 115 V (for TYPE 1571-AL) or 230 V (for TYPE 1571-AH), set by a front-panel screwdriver adjustment.
**Frequency:** 60-cycle models operate from 57 to 63 c/s but can be modified by connection change to operate from 48 to 63 c/s; 400-cycle models operate from 350 to 450 c/s.
**Power Required:** No load, 25 W; full load, 115 W.
**Ambient Temperature:** Operating, −29° to +52°C; in storage, −54° to 85°C.

**Mechanical Data:**

| *Width* | | *Height* | | *Depth* | | *Net Weight* | | *Shipping Weight* | |
|---|---|---|---|---|---|---|---|---|---|
| *in* | *mm* | *in* | *mm* | *in* | *mm* | *lb* | *kg* | *lb* | *kg* |
| 19 | 485 | 7 | 180 | 12* | 305 | 52½ | 24.5 | 103 | 47 |

* Behind panel.

| *Output Voltage* | *Correction Range* %* | *Output Current (A)* | *KVA* | *Max Response Speed (V/s)* | *Accuracy (% of output V)* | *Mounting* | 60 c/s* | | 400 c/s | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *Type Number* | *Catalog Number* | *Type Number* | *Catalog Number* |
| 115 V Adjustable ±10% | 90 to 110 | 50 | 5.8 | 40 | 0.25 | Rack | **1571-AL** | 1571-9831 | **1571-ALJ** | 1571-9551 |
| | 82 to 124 | 25 | 2.9 | 80 | 0.5 | Rack | **1571-AL2** | 1571-9898 | **1571-AL2J** | 1571-9556 |
| 230 V Adjustable ±10% | 95 to 105 | 40 | 9.2 | 40 | 0.25 | Rack | **1571-AH5** | 1571-9516 | **1571-AH5J** | 1571-9530 |
| | 90 to 110 | 20 | 4.6 | 80 | 0.25 | Rack | **1571-AH** | 1571-9817 | **1571-AHJ** | 1571-9522 |
| | 82 to 124 | 10 | 2.3 | 160 | 0.5 | Rack | **1571-AH2** | 1571-9770 | **1571-AH2J** | 1571-9526 |

* Ranges given are for 57- to 63-cycle operation. For 48- to 63-cycle operation, corresponding correction ranges are 95 to 105%, 91 to 109%, and 84 to 119%.

## TYPE 1581-A and TYPE 1582-A

**Frequency:** 60-cycle models operate from 57 to 63 c/s but can be modified by a connection change to operate from 48 to 63 c/s (50 to 60, nominal); 400-cycle models operate from 350 to 450 c/s.
**Response:** Rms. **Distortion:** None added. **Efficiency:** >98%.

**Power Required:** TYPE 1581-A — no load, 25 W; full load, 115 W. TYPE 1582-A — no load, 45 W; full load, 120 W.
**Ambient Temperature:** Operating, −20° to +52°C; in storage, −54° to 85°C.

**Mechanical Data:**

**TYPE 1581**

| | *Width* | | *Height* | | *Depth* | | *Net Wt* | | *Ship Wt* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *in* | *mm* | *in* | *mm* | *in* | *mm* | *lb* | *kg* | *lb* | *kg* |
| *Without case* | 19 | 485 | 7 | 180 | 10½ | 270 | 41½ | 19 | 92 | 42 |
| *Bench* | 19 | 485 | 7⅜ | 190 | 12 | 305 | 51 | 23.5 | 100 | 46 |
| *Rack* | 19 | 485 | 7 | 180 | 11¾* | 300 | 51 | 23.5 | 100 | 46 |
| *Wall* | 19½ | 495 | 8⅛ | 210 | 11¼ | 290 | 54 | 24.5 | 104 | 48 |

* Behind panel.

**TYPE 1582**

| | *Width* | | *Height* | | *Depth* | | *Net Wt* | | *Ship Wt* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *in* | *mm* | *in* | *mm* | *in* | *mm* | *lb* | *kg* | *lb* | *kg* |
| *Without case* | 19 | 485 | 7 | 180 | 14¼ | 365 | 61 | 28 | 110 | 50 |
| *Bench* | 19 | 485 | 7⅜ | 190 | 16 | 410 | 71 | 33 | 121 | 55 |
| *Rack* | 19 | 485 | 7 | 180 | 15¾* | 400 | 71 | 33 | 121 | 55 |
| *Wall* | 19½ | 495 | 8⅛ | 210 | 16 | 410 | 77 | 35 | 126 | 58 |

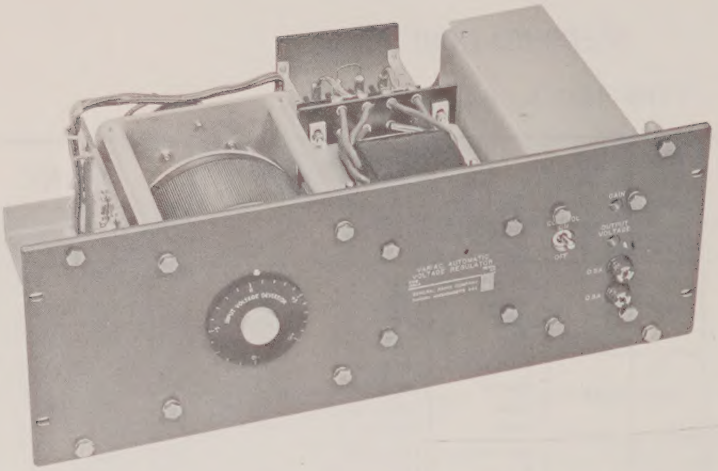
* Behind panel.

## SPECIFICATIONS (Cont)

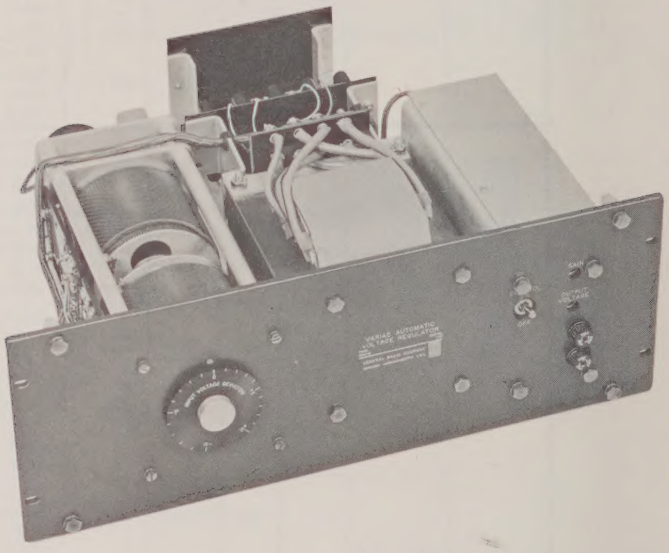
### TYPE 1581-A and TYPE 1582-A

| *Output Voltage* | *Correction Range* %* | *Output Current (A)* | *KVA* | *Max Response Speed (V/s)* | *Accuracy (% of output V)* | *Mounting or Style* | 60 c/s* | | 400 c/s | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *Type Number* | *Catalog Number* | *Type Number* | *Catalog Number* |
| 115 V Adjustable ±10% | 90 to 110 | 50 | 5.8 | 40 | 0.25 | No cabinet | **1581-AL** | 1581-9831 | **1581-ALJ** | 1581-9551 |
| | | | | | | Bench | **1581-ALM** | 1581-9964 | **1581-ALMJ** | 1581-9552 |
| | | | | | | Rack | **1581-ALR** | 1581-9974 | **1581-ALRJ** | 1581-9554 |
| | | | | | | Wall | **1581-ALW** | 1581-9980 | **1581-ALWJ** | 1581-9555 |
| | | 85 | 9.8 | 20 | 0.25 | No Cabinet | **1582-AL** | 1582-9831 | **1582-ALJ** | 1582-9551 |
| | | | | | | Bench | **1582-ALM** | 1582-9964 | **1582-ALMJ** | 1582-9552 |
| | | | | | | Rack | **1582-ALR** | 1582-9974 | **1582-ALRJ** | 1582-9554 |
| | | | | | | Wall | **1582-ALW** | 1582-9980 | **1582-ALWJ** | 1582-9555 |
| | 82 to 124 | 25 | 2.9 | 80 | 0.5 | No cabinet | **1581-AL2** | 1581-9898 | **1581-AL2J** | 1581-9556 |
| | | | | | | Bench | **1581-ALM2** | 1581-9901 | **1581-ALM2J** | 1581-9557 |
| | | | | | | Rack | **1581-ALR2** | 1581-9923 | **1581-ALR2J** | 1581-9558 |
| | | | | | | Wall | **1581-ALW2** | 1581-9924 | **1581-ALW2J** | 1581-9559 |
| | | 42.5 | 4.9 | 40 | 0.5 | No cabinet | **1582-AL2** | 1582-9898 | **1582-AL2J** | 1582-9556 |
| | | | | | | Bench | **1582-ALM2** | 1582-9901 | **1582-ALM2J** | 1582-9557 |
| | | | | | | Rack | **1582-ALR2** | 1582-9923 | **1582-ALR2J** | 1582-9558 |
| | | | | | | Wall | **1582-ALW2** | 1582-9924 | **1582-ALW2J** | 1582-9559 |
| 230 V Adjustable ±10% | 95 to 105 | 40 | 9.2 | 40 | 0.25 | No cabinet | **1581-AH5** | 1581-9516 | **1581-AH5J** | 1581-9530 |
| | | | | | | Bench | **1581-AHM5** | 1581-9517 | **1581-AHM5J** | 1581-9531 |
| | | | | | | Rack | **1581-AHR5** | 1581-9518 | **1581-AHR5J** | 1581-9532 |
| | | | | | | Wall | **1581-AHW5** | 1581-9521 | **1581-AHW5J** | 1581-9533 |
| | | 85 | 19.7 | 20 | 0.25 | No cabinet | **1582-AH5** | 1582-9516 | **1582-AH5J** | 1582-9530 |
| | | | | | | Bench | **1582-AHM5** | 1582-9517 | **1582-AHM5J** | 1582-9531 |
| | | | | | | Rack | **1582-AHR5** | 1582-9518 | **1582-AHR5J** | 1582-9532 |
| | | | | | | Wall | **1582-AHW5** | 1582-9521 | **1582-AHW5J** | 1582-9533 |
| | 90 to 110 | 20 | 4.6 | 80 | 0.25 | No cabinet | **1581-AH** | 1581-9817 | **1581-AHJ** | 1581-9522 |
| | | | | | | Bench | **1581-AHM** | 1581-9951 | **1581-AHMJ** | 1581-9523 |
| | | | | | | Rack | **1581-AHR** | 1581-9961 | **1581-AHRJ** | 1581-9524 |
| | | | | | | Wall | **1581-AHW** | 1581-9971 | **1581-AHWJ** | 1581-9525 |
| | | 42.5 | 9.8 | 40 | 0.25 | No cabinet | **1582-AH** | 1582-9817 | **1582-AHJ** | 1582-9522 |
| | | | | | | Bench | **1582-AHM** | 1582-9951 | **1582-AHMJ** | 1582-9523 |
| | | | | | | Rack | **1582-AHR** | 1582-9961 | **1582-AHRJ** | 1582-9524 |
| | | | | | | Wall | **1582-AHW** | 1582-9971 | **1582-AHWJ** | 1582-9525 |
| | 82 to 124 | 10 | 2.3 | 160 | 0.5 | No cabinet | **1581-AH2** | 1581-9770 | **1581-AH2J** | 1581-9526 |
| | | | | | | Bench | **1581-AHM2** | 1581-9771 | **1581-AHM2J** | 1581-9527 |
| | | | | | | Rack | **1581-AHR2** | 1581-9772 | **1581-AHR2J** | 1581-9528 |
| | | | | | | Wall | **1581-AHW2** | 1581-9773 | **1581-AHW2J** | 1581-9529 |
| | | 21.3 | 4.9 | 80 | 0.5 | No cabinet | **1582-AH2** | 1582-9770 | **1582-AH2J** | 1582-9526 |
| | | | | | | Bench | **1582-AHM2** | 1582-9771 | **1582-AHM2J** | 1582-9527 |
| | | | | | | Rack | **1582-AHR2** | 1582-9772 | **1582-AHR2J** | 1582-9528 |
| | | | | | | Wall | **1582-AHW2** | 1582-9773 | **1582-AHW2J** | 1582-9529 |
| 460 V Adjustable ±10% | 95 to 105 | 34 | 15.6 | 40 | 0.25 | No cabinet | **1582-AK5** | 1582-9535 | **1582-AK5J** | 1582-9546 |
| | | | | | | Bench | **1582-AKM5** | 1582-9536 | **1582-AKM5J** | 1582-9547 |
| | | | | | | Rack | **1582-AKR5** | 1582-9537 | **1582-AKR5J** | 1582-9548 |
| | | | | | | Wall | **1582-AKW5** | 1582-9538 | **1582-AKW5J** | 1582-9549 |
| | 90 to 110 | 17 | 7.8 | 80 | 0.25 | No cabinet | **1582-AK** | 1582-9819 | **1582-AKJ** | 1582-9541 |
| | | | | | | Bench | **1582-AKM** | 1582-9534 | **1582-AKMJ** | 1582-9542 |
| | | | | | | Rack | **1582-AKR** | 1582-9426 | **1582-AKRJ** | 1582-9544 |
| | | | | | | Wall | **1582-AKW** | 1582-9821 | **1582-AKWJ** | 1582-9545 |
| | 82 to 124 | 8.5 | 3.9 | 160 | 0.5 | No cabinet | **1582-AK2** | 1582-9391 | **1582-AK2J** | 1582-9395 |
| | | | | | | Bench | **1582-AKM2** | 1582-9392 | **1582-AKM2J** | 1582-9396 |
| | | | | | | Rack | **1582-AKR2** | 1582-9393 | **1582-AKR2J** | 1582-9397 |
| | | | | | | Wall | **1582-AKW2** | 1582-9394 | **1582-AKW2J** | 1582-9398 |

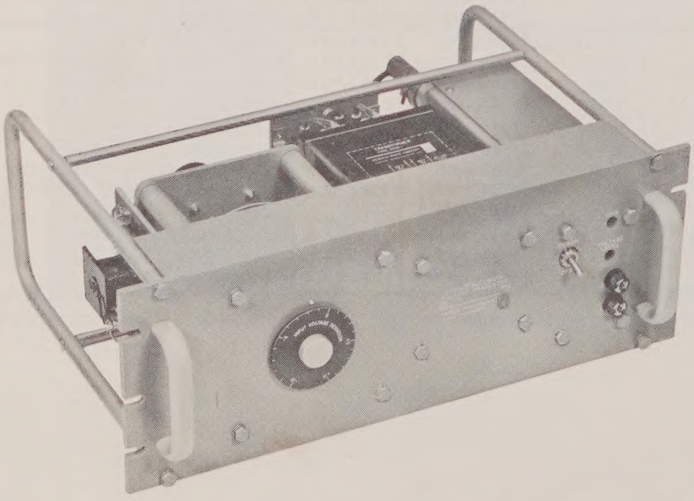
* Ranges listed are for 57- to 63-cycle operation; for 48- to 63-cycle operation, corresponding correction ranges are 95 to 105%, 91 to 109%, and 84 to 119%.



Type 1581-A



Type 1582-A



Type 1571-A

Figure 1-1. Variac Automatic Voltage Regulators.

*SECTION* 1

# INTRODUCTION

## 1.1 PURPOSE

These Variac® Automatic Line-Voltage Regulators (Figure 1-1) are high-speed electro-mechanical regulators that provide constant output voltage at a predetermined level. They yield an accurate, constant voltage for supplying large loads independent of the load power factor and without introducing harmonic distortion.

The regulators are available in three basic models. The Type 1581, for commercial applications, and the Type 1571, for military applications, are basically 6-kVA regulators and are available for 115-volt or 230-volt service (refer to the specifications). The Type 1582 is a nominal 9.8-kVA regulator for commercial applications and is available for 115-, 230-, or 460-volt use. All three basic models are available for operation on line frequencies of either 48 or 63 c/s or 400 c/s. Provision is made for remote programming, remote sensing, and for the use of an external detector.

## 1.2 DESCRIPTION

1.2.1 GENERAL.

The Types 1571-A, 1581-A, and 1582-A Automatic Line-Voltage Regulators comprise three components (see Figure 1-2): a motor-driven Variac adjustable autotransformer for voltage adjustment, a buck-boost step-down transformer to multiply the power rating of the transformer, and a control unit to operate the servo motor on the Variac autotransformer.

1.2.2. CONTROLS.

1.2.2.1 CONTROL Switch. The CONTROL toggle switch on the panel controls the servo amplifier. With this switch in the AUTOMATIC (ON) position, the Variac autotransformer is automatically adjusted to maintain constant output voltage regardless of load variations or input-voltage fluctuations. With the switch in the MANUAL (OFF) position, power is removed from the servo amplifier, permitting manual control of the output voltage by rotation of the INPUT VOLTAGE DEVIATION dial on the front panel.

**WARNING**

**The CONTROL switch does not remove power from the regulator or from any load connected to the regulator.**

1.2.2.2 INPUT VOLTAGE DEVIATION Dial. The INPUT VOLTAGE DEVIATION dial on the panel is calibrated from -10 to +10 in units that roughly correspond (on models with a ± 10-percent correction range) to percent or volts deviation of the input voltage from the desired output voltage. On models with ± 20-percent correction range the dial indication must be doubled to indicate deviation. The approximate calibration denotes the available correction range of the regulator.

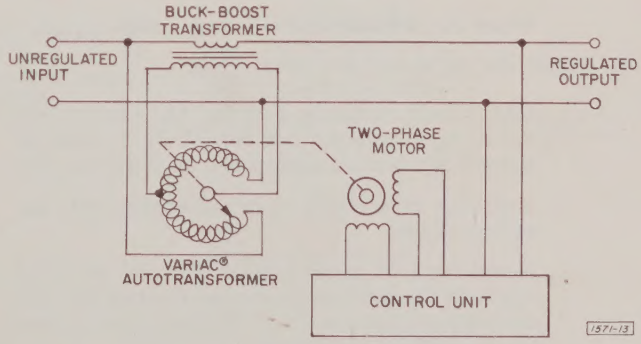



**Figure 1-2. Functional diagram of the three components of the regulators.**

*SECTION* 2

# INSTALLATION

## 2.1 MOUNTING

The Type 1571-A Regulator is designed for relay-rack installation. The Types 1581 and 1582 are primarily for permanent installation, but they can be readily adapted for portable use; they are available in four different mounting styles: rack, bench, wall or without cabinet. The regulators will operate satisfactorily in any position.

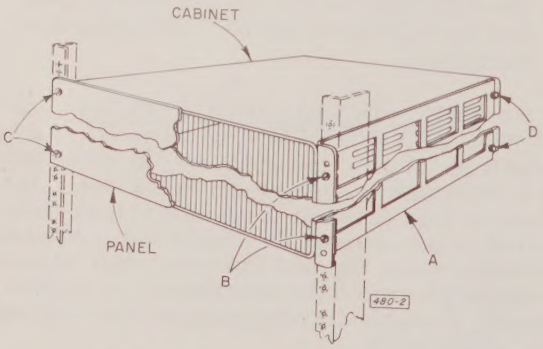



**Figure 2-1. Installation of relay-rack models.**

To install the regulator in a relay rack:

a. Attach each mounting bracket (A, Figure 2-1) to the rack; use the two No. 12-24 roundhead screws (B) in the inside holes on the brackets.

b. Slide the instrument onto the brackets as far as it will go.

c. Insert the four panel screws (C) with attached washers through the panel and the bracket and thread them into the rack. The washers protect the face of the instrument.

d. Toward the rear of each bracket, put a thumbscrew (D) through the slot in the bracket and into the hole in the side of the cabinet.

e. On the rear of the cabinet, remove the two roundhead screws that hold the cabinet to the instrument.

To remove the instrument from the rack, remove only the four panel screws (C) with washers, and draw the instrument forward, out of the rack. To remove the cabinet with the instrument remaining in the rack, remove only the two thumbscrews (D) at the rear of the brackets and pull the cabinet off the instrument from the rear of the rack.

The bench models are shipped complete with end frames attached, as in Figure 2-2.

Four corner holes are provided in the base of the wall models to mount the regulator. Remove the four screws in the corners of the panel and slide the instrument forward, out of the cabinet. Fasten the cabinet securely to the wall and replace the instrument.

The uncased models are shown in Figure 1-1.

In all installations, suitable fuses and disconnect switches should be included (refer to Table 2-1). Note that when the input voltage is 10 or 20 percent less than the desired output voltage, the input current will be 10 or 20 percent greater than the output current. Therefore, always use input fuses of a higher rating than the output fuses. If the voltage drop across the

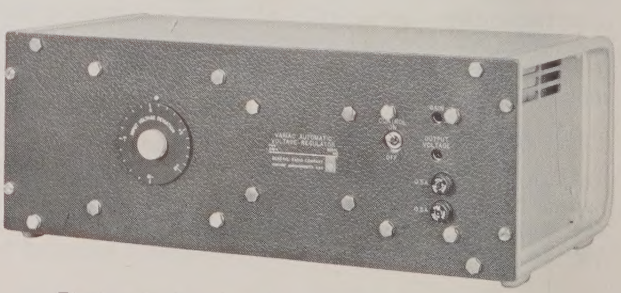


**Figure 2-2. Bench model complete with end frames.**

Table 2-1
FUSE AND DISCONNECT-SWITCH RATINGS.

| REGULATOR VOLTAGE | 115 VOLTS | | | | 230 VOLTS | | | | | | 460 VOLTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REGULATOR TYPE NO. | 1571 and 1581 | | 1582 | | 1571 and 1581 | | | 1582 | | | 1582 | | |
| RANGE | ± 10% | ± 20% | ± 10% | ± 20% | ± 5% | ± 10% | ± 20% | ± 5% | ± 10% | ± 20% | ± 5% | ± 10% | ± 20% |
| DISCONNECT SWITCH (Amperes) | 60 | 30 | 100 | 60 | 60 | 40 | 40 | 100 | 60 | 40 | 60 | 40 | 40 |
| INPUT FUSE (Amperes) | 60 | 30 | 100 | 50 | 50 | 25 | 15 | 90 | 50 | 25 | 40 | 20 | 12 |
| OUTPUT FUSE (Amperes) | 50 | 25 | 90 | 45 | 40 | 20 | 10 | 80 | 45 | 25 | 35 | 17.5 | 9 |

output fuse due to the load current is undesirable, use the remote-sensing feature (refer to paragraph 2.6).

Line cords of the type for electric ranges can be used (refer to the rating plate at the center, rear, of the regulator).

## 2.2 SINGLE-PHASE CONNECTIONS

### 2.2.1 SINGLE-PHASE, ONE LINE GROUNDED.

NOTE

The chassis can be connected to the system ground, if desired. One of the empty tapped holes within the regulator or one of the cabinet-mounting screws can be utilized for the connection.

Figure 2-3 shows the proper connections for either 115- or 230-volt single-phase regulators where one side of the line is grounded. Suitable fuses and a disconnect switch, as listed in Table 2-1, should be provided. Do not use a fuse in the grounded side of the line. If neither side of the line is grounded, refer to paragraph 2.2.2.

### 2.2.2 SINGLE-PHASE, BALANCED, THREE-WIRE OR UNGROUNDED SYSTEMS.

2.2.2.1 Regulating One Side of a Balanced Single-Phase Line. To regulate one side only of a three-wire system, connect the regulator as shown in Figure 2-4. With this connection, regulated power is available on one side of the line to neutral, while the other side of the

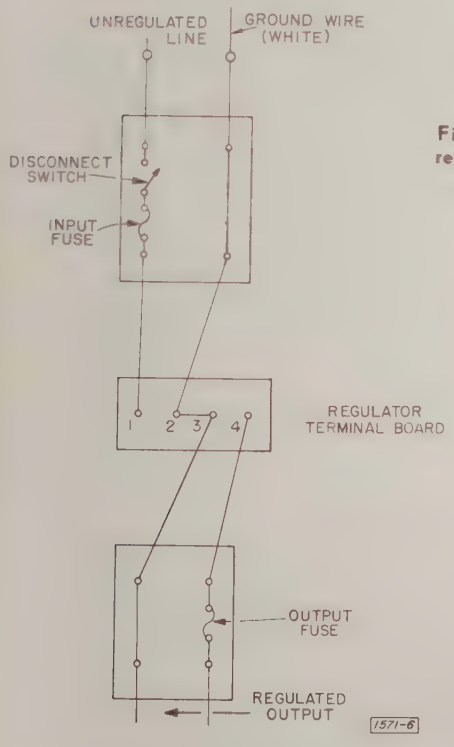
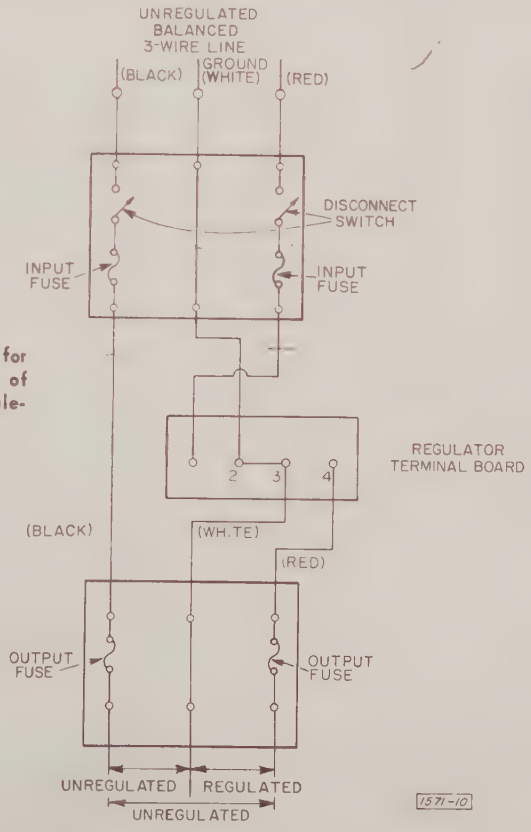



Figure 2-3. Circuit diagram for regulation of single-phase system, one line grounded.

Figure 2-4. Circuit diagram for regulation of one side only of a balanced, three-wire, single-phase line.



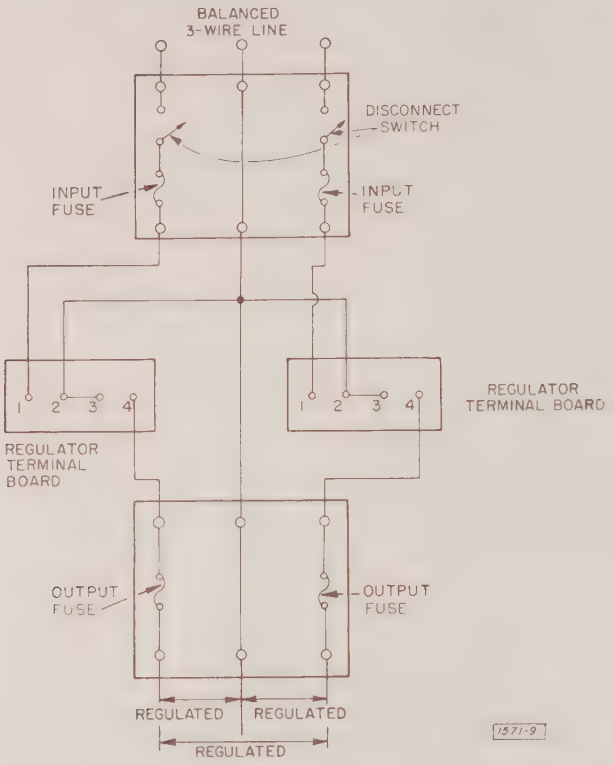



Figure 2-5. Circuit diagram, two regulators, for regulation of both side of a balanced, three-wire line.

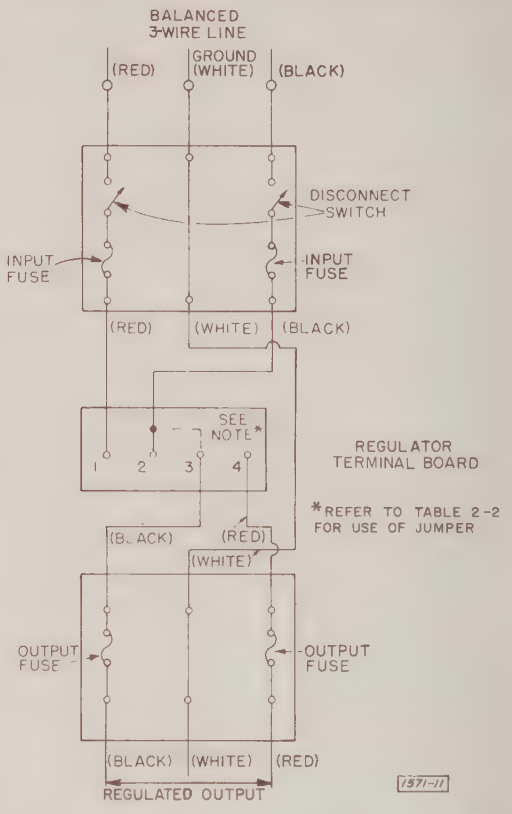



Figure 2-6. Circuit diagram for regulation of line-to-line voltage in a three-wire line.

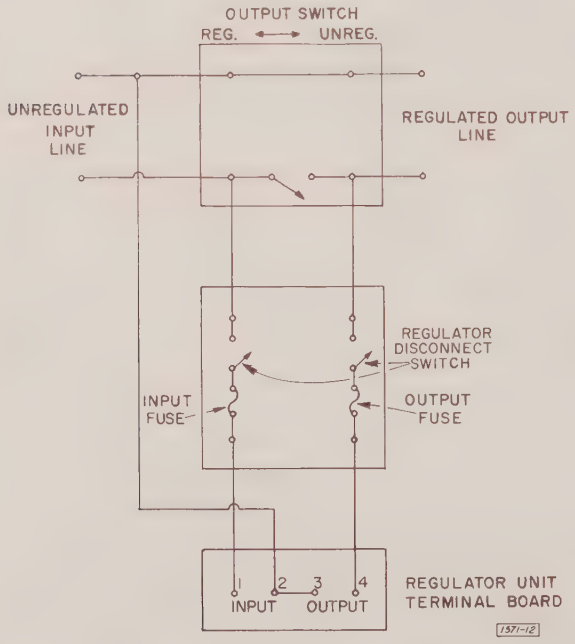



Figure 2-7. Circuit diagram for a single-phase system, one line grounded, where interruption of power is not desirable.

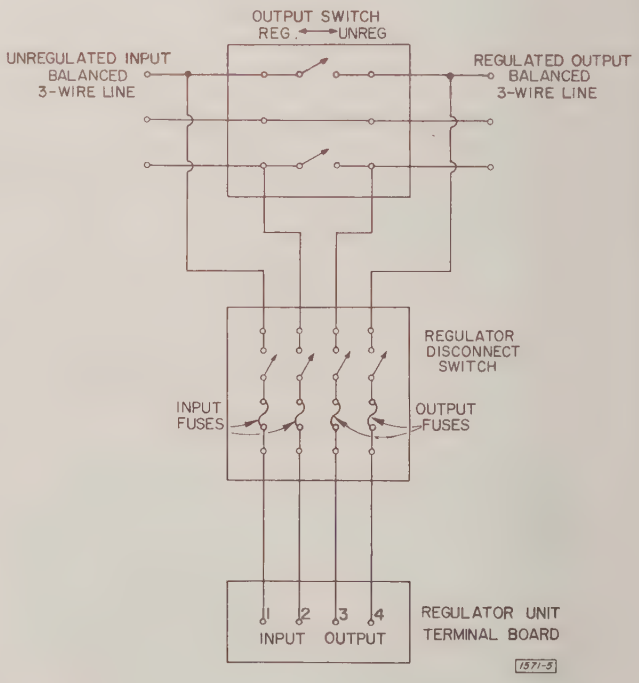



Figure 2-8. Circuit diagram for a balanced, three-wire line, where interruption of power is not desirable.

line-to-neutral and the line-to-line power are unregulated. For the proper sizes of fuses and disconnect switch, refer to Table 2-1.

2.2.2.2 Use of Two Regulators to Regulate Both Sides of a Balanced Line. Each line-to-neutral output and also the line-to-line output can be regulated by the use of two regulators as shown in Figure 2-5. Each regulator maintains constant output voltage from one line to neutral. Thus a balanced output is obtained, regardless of any unbalance in the input voltage or the output load.

The proper sizes of fuses and disconnect switch are shown in Table 2-1.

2.2.2.3 Regulation of Line-to-Line Voltage Only. The connections for the regulation of the line-to-line voltage only, in a balanced three-wire line where neither side is grounded, are shown in Figure 2-6. Install suitable fuses and a disconnect switch as noted in Table 2-1.

As normally supplied, regulators introduce the full correction voltage on one side of the line (see Figure 1-2). The balance between the line-to-neutral voltages is satisfactory in most systems. However, if the unregulated input line is fairly well balanced, a better output-line balance can be obtained by distributing the correction, half on each side of the line. This is accomplished by rewiring the buck-boost transformer, T4, as shown in Table 2-2.

2.2.2.4 Connecting the Regulator when Interruption of Power for Routine Maintenance is not Desirable. In applications where the interruption of power for routine maintenance is not desirable, use of the circuit of Figure 2-7 or 2-8 makes possible the removal of the regulator without shutdown. In these circuits the output switch is normally in the regulated position and the regulator disconnect switch is on. To remove the regulator from the circuit without interrupting the flow of power, proceed as follows:

a. Set the toggle switch on the regulator to the MANUAL position, so that the motor is inoperative.
b. Rotate the input-voltage dial on the regulator unit to zero to reduce the voltage across the output switch to zero.
c. Set the output switch (Figures 2-7 and 2-8) in the unregulated position. This transfers the flow of current from the regulator to the output switch.
d. Turn the regulator disconnect switch off. This removes all voltage from the regulator.

To return the regulator to service:

a. Be sure the toggle switch on the regulator is in the MANUAL position.
b. Rotate the input-voltage dial on the regulator unit to zero.
c. Turn on the regulator disconnect switch (Figures 2-7 and 2-8).
d. Set the output switch to the regulated position.
e. Set the toggle switch on the regulator to the AUTOMATIC position. The output is now regulated.

Table 2-2

INTERNAL CONNECTIONS FOR BUCK-BOOST TRANSFORMER AND INPUT-OUTPUT TERMINALS
(REFER TO PARAGRAPH 2.2.2.3 AND SCHEMATIC DIAGRAMS, FIGURES 4-4, 4-7, and 4-8.)

| *Correction Range* | *As Normally Supplied for 115 Volts* | | *As Normally Supplied for 230 or 460 Volts (Entire Correction on One Side of Line)* | | *For Balanced Correction (230- or 460-Volt, 3-Wire, Balanced, Single-Phase Lines Only)* | |
|---|---|---|---|---|---|---|
| | *Buck-Boost Transformer Terminals (T501)* | *INPUT-OUTPUT Terminals* | *Buck-Boost Transformer Terminals (T501)* | *INPUT-OUTPUT Terminals* | *Buck-Boost Transformer Terminals (T501)* | *INPUT-OUTPUT Terminals* |
| ±5% | | | 5-6-7-8 | 1 | | |
| | | | 9-10-11-12 | 4 | | |
| | | | | 2-3 | | |
| ±10% | 5-6-7-8 | 1 | 5-6 | 1 | 7-8 | 1 |
| | 9-10-11-12 | 4 | 7-8-9-10 | | 11-12 | 4 |
| | | 2-3 | 11-12 | 4 | 5-6 | 3 |
| | | | | 2-3 | 9-10 | 2 |
| ±20% | 5-6 | 1 | 5 | 1 | 5 | 3 |
| | 7-8-9-10 | | 6-9 | | 6-9 | |
| | 11-12 | 4 | 7-10 | | 10 | 2 |
| | | 2-3 | 8-11 | | 7 | 1 |
| | | | 12 | 4 | 8-11 | |
| | | | | 2-3 | 12 | 4 |

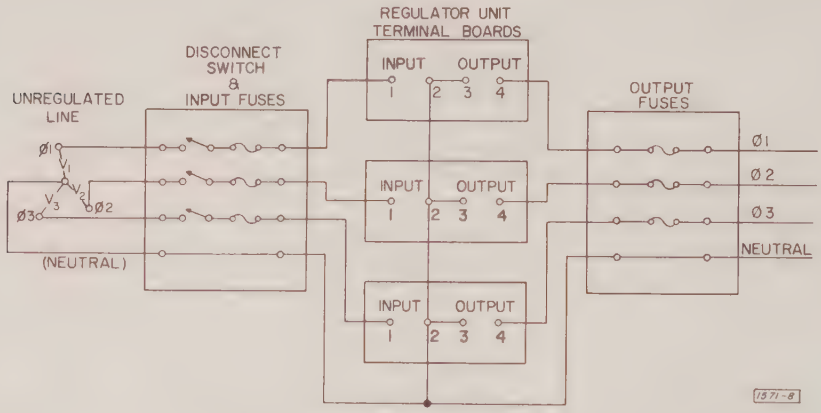



Figure 2-9. Circuit diagram for three regulators, four-wire wye connection.

## 2.3 THREE-PHASE CONNECTIONS

### 2.3.1 CONNECTION OF THREE REGULATORS TO REGULATE THREE-PHASE VOLTAGES.

2.3.1.1 General. To regulate three-phase voltages it may be necessary to regulate each phase independently of the others, since any unbalance may not affect all phases equally. In this case three separate regulators must be used. It is also practical to use two regulators connected in open delta to regulate a three-wire (delta) line.

2.3.1.2 Four-Wire Wye Connection. Figure 2-9 shows the connection of three regulators, with the disconnect switch and input and output fuses. The regulator voltage rating should be equal to the line-to-neutral voltage. Refer to Table 2-1 for appropriate fuse and disconnect-switch ratings.

2.3.1.3 Three-Wire Closed-Delta Connection. The three regulators must be connected as shown in Figure 2-10 to regulate a closed-delta line. Note that the jumpers have been removed from between terminals #2 and #3 on the input-output terminal blocks, and appropriate connections have been made between each terminal #3 and the regulated output line. The regulator voltage rating should be equal to the line-to-line voltage. The output voltage adjustment has sufficient range to permit regulation of line voltages below the nominal rating for the regulator. For example, 230-volt regulators can be used to regulate a 208-volt line. Operation will be normal for input voltage variations within the specified correction range above and below 208 volts.

2.3.1.4 Three-Wire Open-Delta Connection. Two regulators can be used in the open-delta configuration shown in Figure 2-11 to regulate three-wire delta lines. The fuse and switch ratings are the same as for single-phase operation of the selected regulators (refer to Table 2-1.).

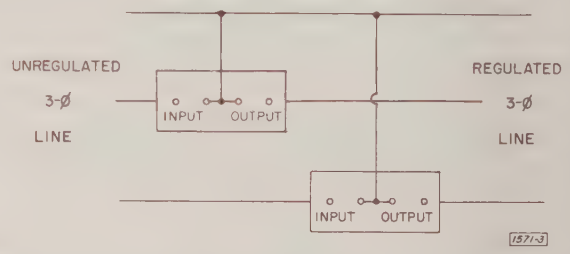



Figure 2-11. Circuit diagram for two regulators, three-wire open-delta connection.

## 2.4 CHANGE OF CORRECTION RANGE (See Figure 2-12)

Table 2-2 shows the connections for the buck-boost transformer for various correction ranges. The speed of correction and correction accuracy are affected by the correction range (refer to the specifications). The nominal line-voltage rating cannot be altered by a wiring change except for the 115- and 230-volt models of the Type 1582 regulator.

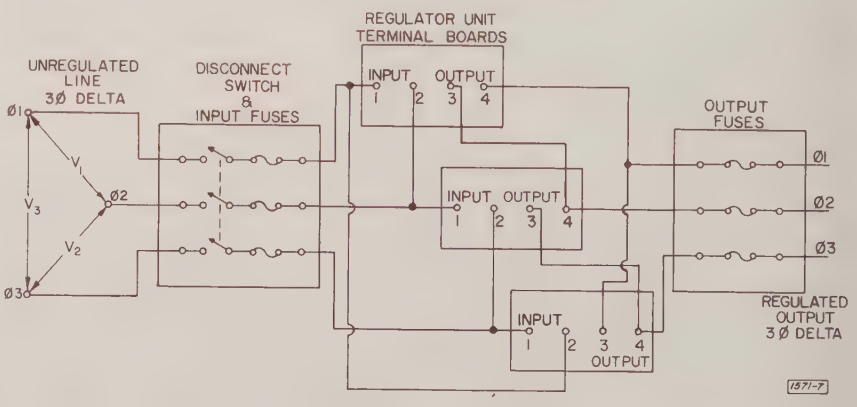



Figure 2-10. Circuit diagram for three regulators, three-wire closed-delta connection.

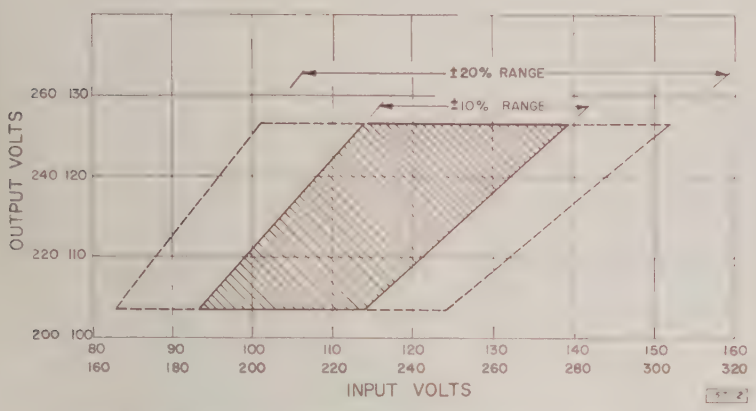



**Figure 2-12. Range of operation for 115- and 230-volt models. (For 460-volt models, multiply 230-volt scales by 2.)**

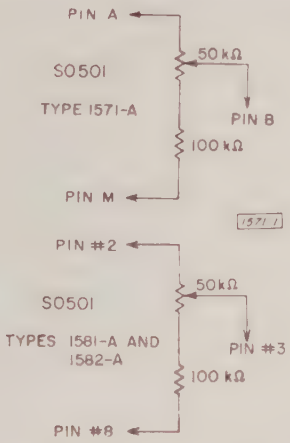



**Figure 2-13. Connections for an external voltage divider. (Refer also to Figure 4-1.)**

## 2.5 CHANGE OF FREQUENCY RANGE

The regulators are normally supplied for operation over a specified frequency range about a nominal 60 c/s or 400 c/s. Operation at a nominal frequency other than that specified for the particular regulator requires a change in the Variac drive motor and reference-phase capacitor. Regulators supplied for a nominal 60 c/s operate from 57 c/s to 63 c/s and utilize the overvoltage connection on the Variac autotransformer. If operation in the range of 48 c/s to 63 c/s is required, the Variac autotransformer must be rewired as indicated on the appropriate schematic diagram. This tap change causes a slight reduction of the total available correction range. No tap change is required for the proper operation of 400-cycle regulators over their entire specified frequency range.

## 2.6 REMOTE SENSING

To utilize the remote-sensing feature, the cable-mounted female plug, SO501, at the rear of the control unit (see Figure 4-1) must be disassembled. On type 1571 Regulators, remove the jumper between terminals E and F and between terminals H and J on SO501. Connect the remote-sensing line to terminals F and H. The connection need not be heavy, as only a few milliamperes of current will be drawn.

On Types 1581 and 1582, remove the jumpers between terminals #7 and #10 and between terminals #9 and #12. Connect the remote-sensing line to terminals #10 and #12. The proper phase-relationship must be observed. If the input line voltage is within specifications, and the arm of the Variac autotransformer moves to one end of its range when power is applied, the phase of the remote-sensing line must be reversed.

## 2.7 REMOTE PROGRAMMING

The regulated output voltage can be varied by an external variable resistor. Connect the resistor from pins A and B to ground on the control-unit connecting plug, SO501, (see Figure 4-1) on the Type 1571 Regulators and between pins #2 and #3 and ground on the Types 1581 and 1582 models. To ensure full-range adjustment, set the OUTPUT VOLTAGE control at its maximum counterclockwise position.

For maximum linearity, use an external voltage divider connected to the control-unit plug, as shown in Figure 2-13. The jumper between pins A and B or pins #2 and #3 (depending on the model) must be removed.

## 2.8 USE OF AN EXTERNAL DETECTOR

If an external detector is used, it should provide a well-filtered signal of approximately +9 volts with respect to ground. For the Type 1571 Regulator, remove the jumper between pins A and B of SO501 (see Figure 4-1) and apply the signal from the external detector to pin B. For Types 1581 and 1582, remove the jumper between terminals #2 and #3 and apply the detector signal to pin #3.

SECTION 3

# THEORY OF OPERATION

## 3.1 GENERAL

The ac output of the regulator is measured and compared with a reference voltage. Any difference voltage is applied to a servo motor that readjusts a Variac autotransformer. The latter, through a step-down transformer, adjusts the voltage added to or subtracted from the input, thus providing a constant output voltage.

## 3.2 VOLTAGE-ADJUSTING SYSTEM

By means of the buck-boost circuit (see Figure 1-2), a large amount of power can be controlled by a Variac autotransformer of considerably smaller power rating. The auxiliary transformer uses multiple windings to provide either a ±10-percent or ±20-percent correction range at 115 or 230 volts. A ±5-percent range is also possible at 230 or 460 volts.

The Duratrak® contact surface of the special ball-bearing Variac autotransformer provides a stable brush track capable of withstanding severe overloads. The ball bearings minimize friction, thereby extending the life of a system demanding continual motion.

## 3.3 CONTROL CIRCUIT

The regulated output voltage is measured by an rms detector, Figure 3-1, to obtain a dc voltage proportional to the ac output voltage. The rms response is effected by proper choice of the rectifier conduction angle. The rectifier is full wave, so that the ripple frequency is well beyond the pass band of the regulator. A ripple filter provides considerable rejection from 90 to 130 c/s, with a small phase shift below 5 c/s. The filtered voltage is compared with a reference voltage from a precision temperature-compensated Zener diode, and the difference between these voltages is ultimately used to readjust the Variac autotransformer. Any such difference or error voltage is fed through a synchronous modulator and low-level amplifier circuit. The amplified error voltage, now synchronous with the input line frequency, is further amplified by a power amplifier and is applied to the control winding of a two-phase servo motor. The reference phase of the motor derives its power from the regulated output line through a capacitor that makes the phase of the reference-winding current 90° out of phase with the control-winding current.

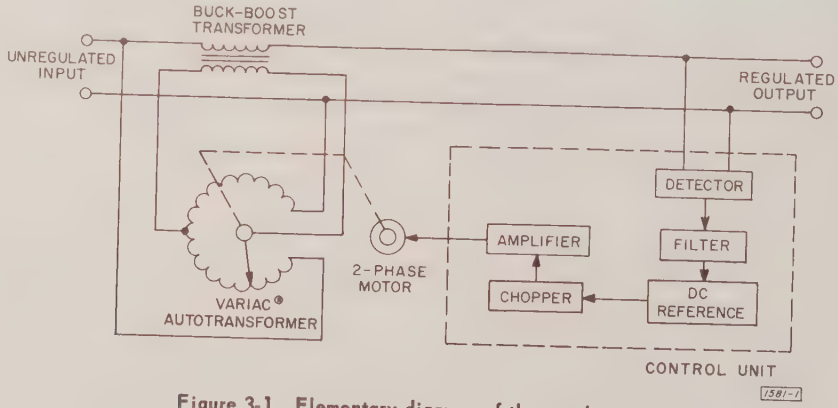



**Figure 3-1. Elementary diagram of the regulators.**

*SECTION* 4

# SERVICE AND MAINTENANCE

## 4.1 WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, Sales Engineering Office, or authorized personnel, will be repaired, or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

## 4.2 SERVICE

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by the use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest sales engineering office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

## 4.3 ADJUSTMENTS

### 4.3.1. OUTPUT VOLTAGE ADJUSTMENT.

By means of the OUTPUT VOLTAGE control (potentiometer R104 on the etched board), the output voltage can be adjusted ten percent higher or lower than the nominal value (115, 230, or 460 volts) to which it is set at the factory. This control is a screwdriver adjustment and is available through a hole in the front panel. Use an accurate voltmeter, preferably of the dynamometer type, to set the output voltage. This control should not require readjustment unless a component in the reference or detector circuit is changed. The allowable input voltage range is always within either 10 or 20 percent of the output-voltage setting.

### 4.3.2 GAIN CONTROL.

The GAIN control (R132, on the etched board) is also a screwdriver adjustment that is available through a hole in the front panel. As this control is turned clockwise (gain is increased), the regulator accuracy is improved but the regulator becomes less stable. If the GAIN control is set too far clockwise, the motor speed will jump back and forth (overshoot) several times after each correction. At full gain the motor may oscillate continuously. The GAIN control is set at the factory to give just a trace of overshoot. If this is objectionable, reduce the gain slightly. If somewhat greater accuracy is needed and more overshoot can be tolerated, increase the gain as necessary.

### 4.3.3 FILTER.

An RC filter with a broad notch is used to reject the ripple component of the detector output voltage. It is factory tuned by means of a 54-cycle input line. This adjustment should not be disturbed unless it is absolutely necessary. On the Type 1571-A Regulators, this tuning is fixed; no further adjustment is possible. On the Types 1581-A and 1582-A models, the notch frequency can be shifted slightly by readjustment of resistor R105 on the etched-circuit board (Figure 4-5). Proper tuning is indicated by minimum input power on a 0-50 wattmeter with no load connected to the regulator output. Proper tuning is also indicated by the minimum steady-state ac voltage between anchor terminals #10 and #11 on the terminal plate of the Variac autotransformer (Figure 4-1).

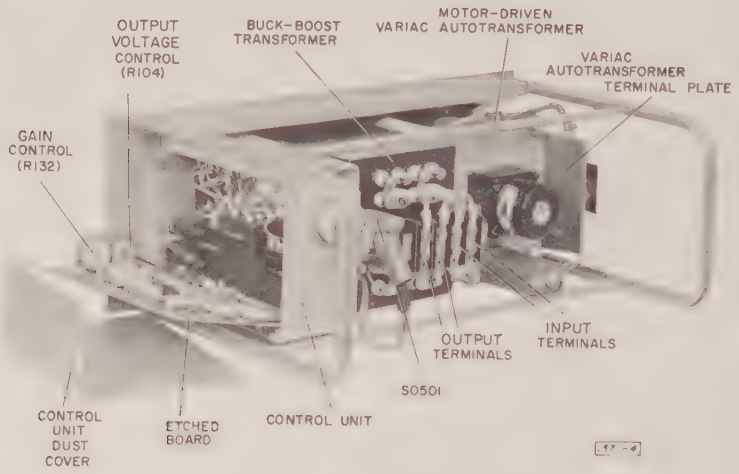



**Figure 4-1. Rear view of regulator with dust cover removed and etched board swung out for access to components and wiring.**

## 4.4 ACCESS TO COMPONENTS

All wiring is easily accessible to bench servicing; no sub-assemblies need to be removed from the front panel. To remove the dust cover from the control unit (Figure 4-1), remove two screws from the top and two from the side of the unit. Remove only the two screws at the top of the etched-circuit board. This allows the board to swing down, exposing all components and the wiring of the control unit. Removal of four 1/4-inch bolts in the front panel will allow removal of the control unit from the regulator, if necessary.

## 4.5 MOTOR-DRIVEN VARIAC® AUTOTRANSFORMER

### 4.5.1 MAINTENANCE.

Clean the Duratrak contact surface of the Variac autotransformer periodically; use a soft cloth and a safe solvent such as alcohol or "white" (nonleaded) gasoline.

**CAUTION**

**Do not use abrasives; they may destroy the stabilized contact surface.**

Inspect the brush assembly periodically; note any unevenness of wear or evidence of arcing or pitting of the brush-track surface. Excessive load current accelerates brush deterioration and damages windings. Rapid brush failure is a sure sign of overload.

Two brushes are used on the autotransformer, one on the outer-circumference brush track and one on the inner take-off collar. Type numbers of replacement brushes for each model are given in Table 4-1.

Under normal conditions, the inner brush is not subject to wear and it seldom needs replacing. However, if this brush must be replaced, use care when tightening the holding screws; the brush holder must not bind or restrict the action of the brush spring.

To remove the outer brush, remove the two screws on the brush assembly. Note that the brush pigtail is secured to the radiator by one of these screws.

Newly installed or reinstalled brushes must be correctly seated for proper operation. With the power off, a few swings of the brush over the abrasive side of a piece of crocus cloth resting on the brush track will effectively mate brush and track.

**CAUTION**

**Do not loosen the nuts that secure the motor to the back plate of the Variac autotransformer, as this may result in shaft misalignment and possible degradation of regulator performance.**

### 4.5.2 LUBRICANTS.

All bearings and gears are factory lubricated with MIL-approved oils and greases; relubrication will not normally be required. Proper lubrication requires disassembly of the Variac autotransformer and servo gear motor, with subsequent precise realignment of the motor and Variac shafts. If relubrication is desired, lubricate the gear-shaft bearings with Emoline 2958 (Shell Oil Co.). All other bearings and gears should be lubricated with Shell 7A. Equivalent compatible lubricants can be used.

If in doubt about lubricant compatability, contact the General Radio Company.

**Table 4-1**
**REPLACEMENT BRUSHES FOR THE VARIAC AUTOTRANSFORMER**

| *Type Number* | *Regulator Output Voltage** | | | |
|---|---|---|---|---|
| | *115V* | | *230V, 460V* | |
| | *Brush Type Numbers* | | | |
| | *Inner* | *Outer* | *Inner* | *Outer* |
| 1571 | W10-4180 (uses 2) | VBT 10 | W10-4180 (uses 2) | VBT 11 |
| 1581 | W10-4180 (uses 2) | VBT 10 | W10-4180 (uses 2) | VBT 11 |
| 1582 | W5-4180 | VB 3 | W5-4180 | VB 1 |

*May differ from data on Variac autotransformer terminal plate.

## 4.6 TROUBLE-SHOOTING

### 4.6.1 DETAILED TROUBLE-SHOOTING DATA.

a. No motor torque; Variac autotransformer does not respond, but can be turned freely by means of dial.

1. Be sure switch is set to the AUTOMATIC CONTROL position.
2. Control-unit fuses may have blown.
3. GAIN control may be set to minimum. Rotate control clockwise, to increase gain.
4. Be sure input voltage at regulator terminal board is correct.
5. Be sure control unit cable is plugged into control unit.
6. Coupling between motor and Variac autotransformer may be loose.
7. Measure the primary voltages of transformers T101 and T102. The voltage should vary over the regulator correction range as the the Variac autotransformer dial is rotated.
8. Measure the motor voltages at the Variac autotransformer terminal plate (see Figure 4-1). The voltage between terminals #8 and #9 should be 105 volts, ac. The voltage between terminals #10 and #11 should be approximately 22 volts, ac, over most of the dial range and should give a minimum at some intermediate dial setting.
9. If the voltages are correct, check for an open motor winding. To do this, disconnect the cable from the control unit (at SO501). Remove the cable wire from anchor terminal #8 on the Variac terminal plate. For 60-cycle models, the dc resistance between terminals #8 and #9 should be 400 ohms; between terminals #10 and #11 it should be 11 ohms. For 400-cycle models, the dc resistance between terminals #8 and #9 should be 25 ohms; between terminals #10 and #11 it should be 2.3 ohms.
10. Perform the tests listed in Table 4-2.

b. The Variac autotransformer is at the limit of its travel (against the stop) and does not move. Full motor torque prevents manual rotation of the dial.

1. Be sure the input voltage on the regulator terminal board is within the range of the regulator.
2. Check the adjustment of the OUTPUT VOLTAGE control.
3. Be sure the Variac autotransformer brush is in continuous contact with the track.
4. Set the switch to MANUAL CONTROL to check the motor and gear train. The dial should now rotate freely by hand.
5. Perform the tests listed in Table 4-2.

c. Poor accuracy; Variac autotransformer behaves sluggishly or irregularly in either or both directions.

1. Turn the GAIN control clockwise (increase the gain).
2. Check for arcing of the Variac brush (refer to paragraph 4.5.1).
3. Replace power transistors Q108 and Q109.
4. Turn the switch to MANUAL CONTROL; rotate the dial to be sure the motor and Variac autotransformer are not binding.
5. Perform the tests listed in Table 4-2.

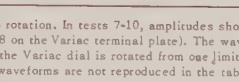
d. Motor oscillates or hunts.

1. Turn the GAIN control counterclockwise (reduce the gain) to improve the stability.
2. Be sure the Variac brush is in continuous contact with the track.

### 4.6.2 VOLTAGE AND WAVEFORM MEASUREMENTS.

Voltage and waveform data are given in Table 4-2. Use a 20,000 ohms/volt dc meter or an oscilloscope as indicated, to measure the voltages. Set the regulated output voltage to the nominal value except as noted.

Table 4-2
TROUBLE-SHOOTING TESTS

| Test No. | Measure | Normal Indication |
|---|---|---|
| 1 | Voltage across C116 | 21 volts, dc |
| 2 | Voltage across C117 | -21 volts, dc |
| 3 | Voltage from A.T. #111 to ground | +10 volts, dc |
| 4 | Voltage across CR110 | 8.5 - 9.5 volts, dc |
| 5 | *Waveform at A.T. #112 | |
| 6 | *Waveform at A.T. #116 | |
| 7 | *Waveform at base of Q101 | |
| 8 | *Waveform on terminal #1 of T103 | |
| 9 | *Waveform at A.T. #119 | |
| 10 | *Waveform at A.T. #117 |   |

*Measured with an oscilloscope. GAIN control set at 50% rotation. In tests 7-10, amplitudes shown are with motor reference winding disconnected (terminal #8 on the Variac terminal plate). The waveform amplitude and phase should vary (through a null) as the Variac dial is rotated from one limit to the other. Some minor aberrations that are present on the waveforms are not reproduced in the table.

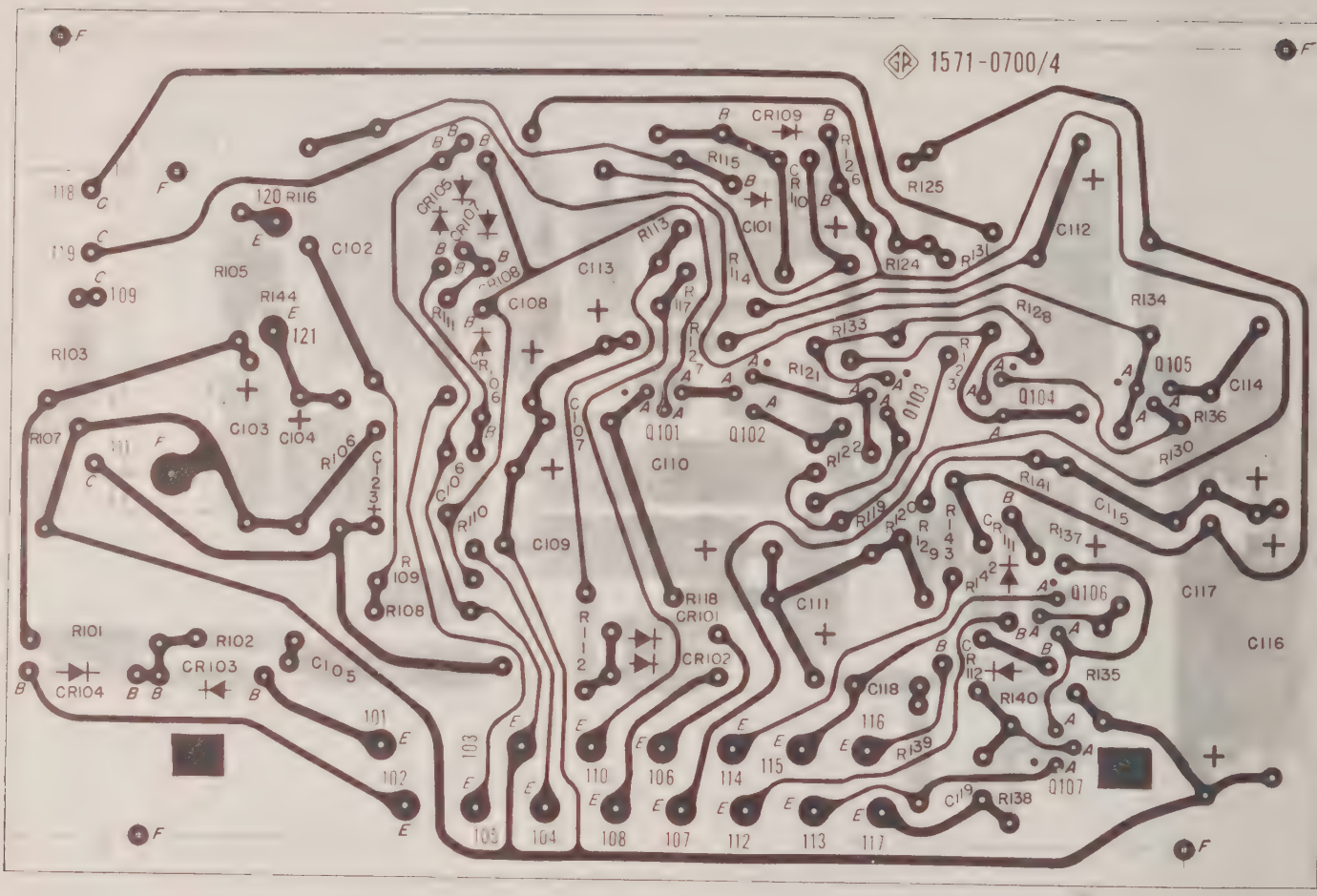



Figure 4-2. Etched board, Type 1571-A Regulator.
(Complete etched-board assembly is 1571-2701.)

NOTE: The number appearing on the foil side is not the part number.

## PARTS LIST

### TYPE 1571 VARIAC AUTOMATIC VOLTAGE REGULATOR
### PARTS LIST FOR CONTROL UNIT

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| | **CAPACITORS** | |
| C101 | Electrolytic, 10μF +100-10% 50V | 8420-3950 |
| C102 | Electrolytic, (Tantalum) 1μF ±10% 200V | 8420-1600 |
| C103 | Electrolytic, (Tantalum) 15μF ±10% 35V | 8420-4020 |
| C104 | Electrolytic, (Tantalum) 3.3μF ±10% 35V | 8420-4000 |
| C105 | Paper, 0.001μF ±10% 100V | 8420-1360 |
| C106 | Ceramic, 0.01μF +20% 500V | 8420-1640 |
| C107 | Ceramic, 0.01μF +20% 500V | 8420-1640 |
| C108 | Electrolytic, 50μF +100-10% 25V | 8420-3940 |
| C109 | Electrolytic, 50μF +100-10% 25V | 8420-3940 |
| C110 | Electrolytic, 250μF +100-10% 5V | 8420-3900 |
| C111 | Electrolytic, 15μF +100-10% 25V | 8420-3930 |
| C112 | Electrolytic, 100μF +100-10% 15V | 8420-3920 |
| C113 | Electrolytic, 15μF +100-10% 25V | 8420-3930 |
| C114 | Electrolytic, 10μF +100-10% 50V | 8420-3950 |
| C115 | Electrolytic, 50μF +100-10% 5V | 8420-3910 |
| C116 | Electrolytic, 50μF +100-10% 25V | 8420-3940 |
| C117 | Electrolytic, 50μF +100-10% 25V | 8420-3940 |
| C118 | Ceramic, 0.01μF +20% 500V | 8420-1640 |
| C119 | Ceramic, 470μF 20% 500V | 8420-1620 |
| C120 | Paper, 0.1μF +10% 100V | 8420-1010 |
| C121 | Paper, 0.1μF +10% 100V | 8420-1010 |
| C123 | Electrolytic, (Tantalum) 1μF ±10% 35V | 8420-4010 |
| | **RESISTORS** | |
| R101 | Film, 549Ω ±1% 1/4W | 6350-0549 |
| R102 | Carbon, 240kΩ ±5% 1/2W | 6100-4245 |
| R103 | Film, 20kΩ ±1% 1/4W | 6350-2200 |
| R104 | Potentiometer, 10kΩ ±10% | 8420-4200 |
| R105 | Film, 1.3kΩ +1% 1/4W | 6350-1130 |
| R106 | Film, 12.1kΩ ±1% 1/4W | 6350-2121 |
| R107 | Film, 2.15kΩ ±1% 1/4W | 6350-1215 |
| R108 | Carbon, 6.8kΩ ±5% 1/2W | 6100-2685 |
| R109 | Carbon, 11kΩ ±5% 1/2W= | 6100-3115 |
| R110 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R111 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R112 | Carbon, 22Ω ±5% 1/2W | 6100-0225 |
| R113 | Carbon, 1.5kΩ ±5% 1W | 6110-2155 |
| R114 | Carbon, 6.2kΩ ±5% 1/2W | 6100-2625 |
| R115 | Carbon, 1.6kΩ ±5% 1/2W | 6100-2165 |
| R116 | Carbon, 33kΩ ±5% 1/2W | 6100-3335 |
| R117 | Carbon, 75Ω ±5% 1/2W | 6100-0755 |
| R118 | Carbon, 2MΩ ±5% 1/2W | 6100-5205 |
| R119 | Carbon, 22kΩ ±5% 1/2W | 6100-3225 |
| R120 | Carbon, 5.1kΩ ±5% 1/2W | 6100-2515 |
| R121 | Carbon, 15kΩ ±5% 1/2W | 6100-3155 |
| R122 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R123 | Carbon, 24kΩ ±5% 1/2W= | 6100-3245 |
| R124 | Carbon, 6.2kΩ +5% 1/2W | 6100-2625 |
| R125 | Carbon, 1.1kΩ ±5% 1/2W | 6100-2115 |
| R126 | Carbon, 15kΩ ±5% 1/2W | 6100-3155 |
| R127 | Carbon, 470Ω ±5% 1/2W | 6100-1475 |
| R128 | Carbon, 1kΩ +5% 1/2W | 6100-2105 |
| R129 | Carbon, 1.1kΩ ±5% 1/2W | 6100-2115 |

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| | **RESISTORS (Cont.)** | |
| R130 | Carbon, 20kΩ ±5% 1/2W | 6100-3205 |
| R131 | 0Ω | 5080-1000 |
| R132 | Potentiometer, 10kΩ ±10% | 8420-4200 |
| R133 | Carbon, 10kΩ ±5% 1/2W | 6100-3105 |
| R134 | Carbon, 6.2kΩ ±5% 1/2W | 6100-2625 |
| R135 | Carbon, 1kΩ ±5% 1/2W | 6100-2105 |
| R136 | Carbon, 5.1kΩ ±5% 1/2W | 6100-2515 |
| R137 | Carbon, 3.3kΩ ±5% 1/2W | 6100-2335 |
| R138 | Carbon, 47kΩ ±5% 1/2W | 6100-3475 |
| R139 | Carbon, 470Ω ±5% 1/2W | 6100-1475 |
| R140 | Carbon, 1kΩ ±5% 1/2W | 6100-2105 |
| R141 | Carbon, 180Ω ±5% 1/2W | 6100-1185 |
| R142 | Carbon, 180Ω +5% 1/2W | 6100-1185 |
| R143 | Carbon, 1.5kΩ +5% 1/2W | 6100-2155 |
| R144 | Carbon, ±5% Lab Select 1/2W | 6100- |
| | **DIODES AND RECTIFIERS** | |
| CR101 | Diode, 1N3253 | 6081-1001 |
| CR102 | Diode, 1N3253 | 6081-1001 |
| CR103 | Diode, 1N645 | 6082-1016 |
| CR104 | Diode, 1N645 | 6082-1016 |
| CR105 | Diode, 1N645 | 6082-1016 |
| CR106 | Diode, 1N645 | 6082-1016 |
| CR107 | Diode, 1N645 | 6082-1016 |
| CR108 | Diode, 1N645 | 6082-1016 |
| CR109 | Diode, 1N968A | 6083-1017 |
| CR110 | Diode, 1N935 | 6083-1026 |
| CR111 | Diode, 1N645 | 6082-1016 |
| CR112 | Diode, 1N645 | 6082-1016 |
| CR113 | Rectifier, 1N254 | 6081-1013 |
| CR114 | Rectifier, 1N254 | 6081-1013 |
| CR115 | Rectifier, 1N254 | 6081-1013 |
| CR116 | Rectifier, 1N254 | 6081-1013 |
| | **TRANSISTORS** | |
| Q101 | 2N338 | 8210-1021 |
| Q102 | 2N338 | 8210-1021 |
| Q103 | 2N1305 | 8210-1305 |
| Q104 | 2N1304 | 8210-1304 |
| Q105 | 2N1305 | 8210-1305 |
| Q106 | 2N651A | 8210-1051 |
| Q107 | 2N651A | 8210-1051 |
| Q108 | 2N1011 | 8210-1050 |
| Q109 | 2N1011 | 8210-1050 |
| | **MISCELLANEOUS** | |
| J101 | Connecting Device Etched Circuit Assembly, complete | 8420-3400 1571-2701 |
| F101, 102 | Fuses, FUF 1, 0.5 ampere | 5330-1000 |
| S101 | Switch | 8420-3200 |
| T101 | Transformer | 0745-4270 |
| T102 | Transformer | 0345-4007 |
| T103 | Transformer | 0745-4280 |

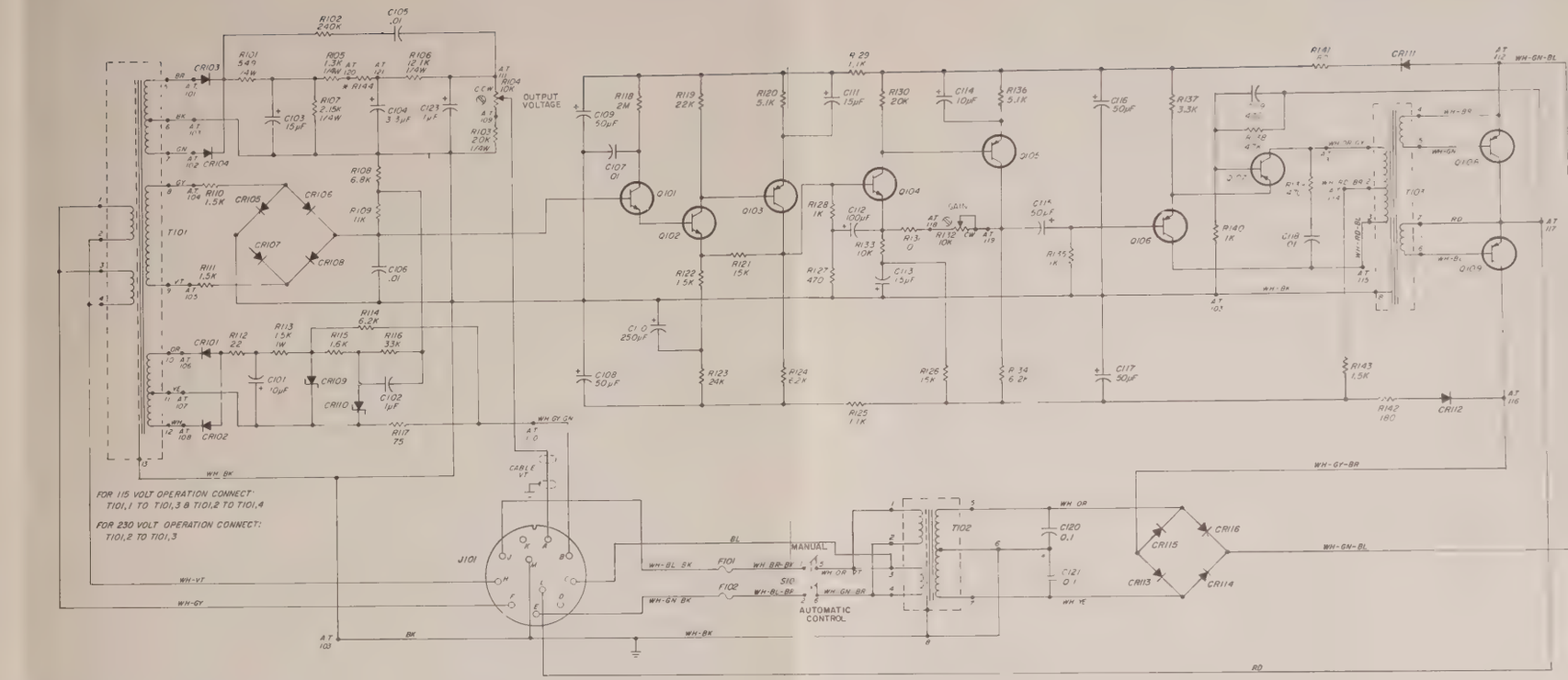

OUTPUT VOLTAGE
FOR 115 VOLT OPERATION CONNECT: T101,1 TO T101,3 & T101,2 TO T101,4
FOR 230 VOLT OPERATION CONNECT: T101,2 TO T101,3
MANUAL
AUTOMATIC CONTROL
NOTE UNLESS SPECIFIED
1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4. RESISTORS 1/2 WATT
5. RESISTANCE IN OHMS K 1000 OHMS M 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS LESS THAN ONE IN MICROFARADS
7. KNOB CONTROL
8. SCREWDRIVER CONTROL
9. AT ANCHOR TERMINAL
10. TP TEST POINT
* R144 LAB ADJUST
BOTTOM VIEW
Q108, Q109
Q101 – Q107

Figure 4-3. Schematic diagram of control unit, Type 1571-A Regulator.

## PARTS LIST

### TYPE 1571 VARIAC AUTOMATIC VOLTAGE REGULATOR PARTS LIST FOR POWER CIRCUIT

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| C506 | Capacitor, Paper, 0.22μF +20% 400V (Part of Transformer T502) | 8420-1000 |
| C507 | Capacitor, Paper, 0.22μF ±20% 400V (Part of Transformer T502) | 8420-1000 |
| C508 | Capacitor, Oil, 2μF ±10% 600V (Part of Transformer T502) (For 60-cycle motor) | |
| C508 | Capacitor, Oil, 0.15μF ±10% 600V (Part of Transformer T502) (For 400-cycle motor) | |
| L501 | Inductor (Part of Transformer T502) | V10-207 |
| M0501 | Motor, 60-cycle (Part of Transformer T502) | MOD-3000 |
| M0501 | Motor, 400-cycle (Part of Transformer T502) | MOD-3002 |
| S0501 | Socket | 8420-3600 |
| T501 | Transformer | |
| | For 115V, 60 c/s, ± 10% range | 0565-4241 |
| | For 115V, 400 c/s, ± 10% range | 0565-4241 |
| | For 115V, 60 c/s, ± 20% range | 0565-4242 |
| | For 115V, 400 c/s, ± 20% range | 0565-4242 |
| | For 230V, 60 c/s, ± 10% range | 0565-4243 |
| | For 230V, 400 c/s, ± 10% range | 0565-4243 |
| | For 230V, 60 c/s, ± 20% range | 0565-4244 |
| | For 230V, 400 c/s, ± 20% range | 0565-4244 |
| | For 230V, 60 c/s, ± 5% range | 0565-4245 |
| | For 230V, 400 c/s, ± 5% range | 0565-4245 |
| T502 | Transformer | |
| | For 115V, 60-cycle motor | 3060-4700 |
| | For 115V, 400-cycle motor | 3060-4701 |
| | For 230V, 60-cycle motor | 3060-4710 |
| | For 230V, 400-cycle motor | 3060-4711 |

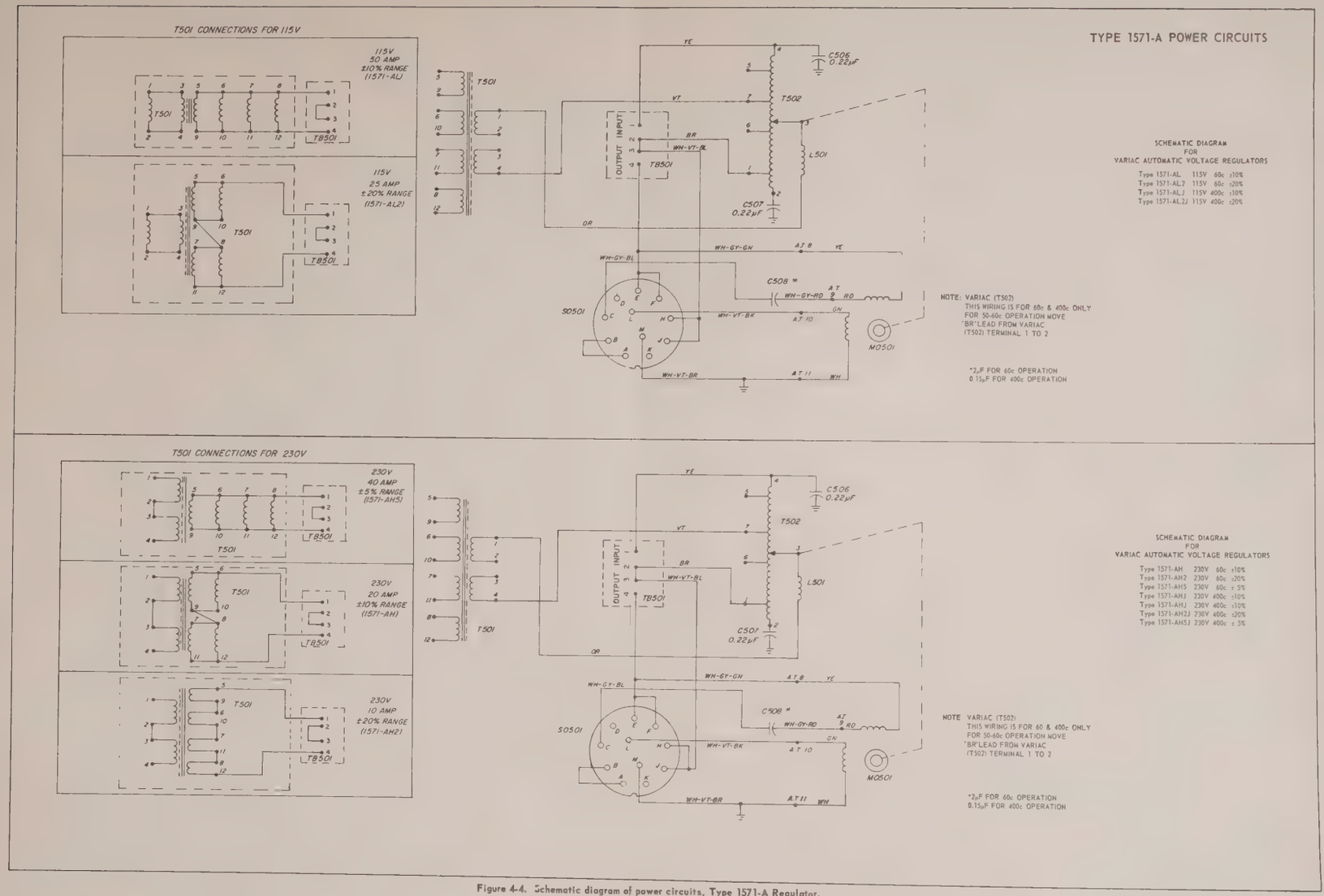

TYPE 1571-A POWER CIRCUITS
T501 CONNECTIONS FOR 115V
115V 50 AMP ±10% RANGE (1571-AL)
115V 25 AMP ±20% RANGE (1571-AL2)
T501 CONNECTIONS FOR 230V
230V 40 AMP ±5% RANGE (1571-AH5)
230V 20 AMP ±10% RANGE (1571-AH)
230V 10 AMP ±20% RANGE (1571-AH2)
T501
T502
TB501
L501
C507 0.22μF
C506 0.22μF
C508 *
S0501
M0501
OUTPUT INPUT
SCHEMATIC DIAGRAM FOR VARIAC AUTOMATIC VOLTAGE REGULATORS
Type 1571-AL 115V 60c ±10%
Type 1571-AL2 115V 60c ±20%
Type 1571-ALJ 115V 400c ±10%
Type 1571-AL2J 115V 400c ±20%
Type 1571-AH 230V 60c ±10%
Type 1571-AH2 230V 60c ±20%
Type 1571-AH5 230V 60c ± 5%
Type 1571-AHJ 230V 400c ±10%
Type 1571-AH2J 230V 400c ±20%
Type 1571-AH5J 230V 400c ± 5%
NOTE: VARIAC (T502) THIS WIRING IS FOR 60c & 400c ONLY FOR 50-60c OPERATION MOVE *BR* LEAD FROM VARIAC (T502) TERMINAL 1 TO 2
*2μF FOR 60c OPERATION 0.15μF FOR 400c OPERATION

Figure 4-4. Schematic diagram of power circuits, Type 1571-A Regulator.

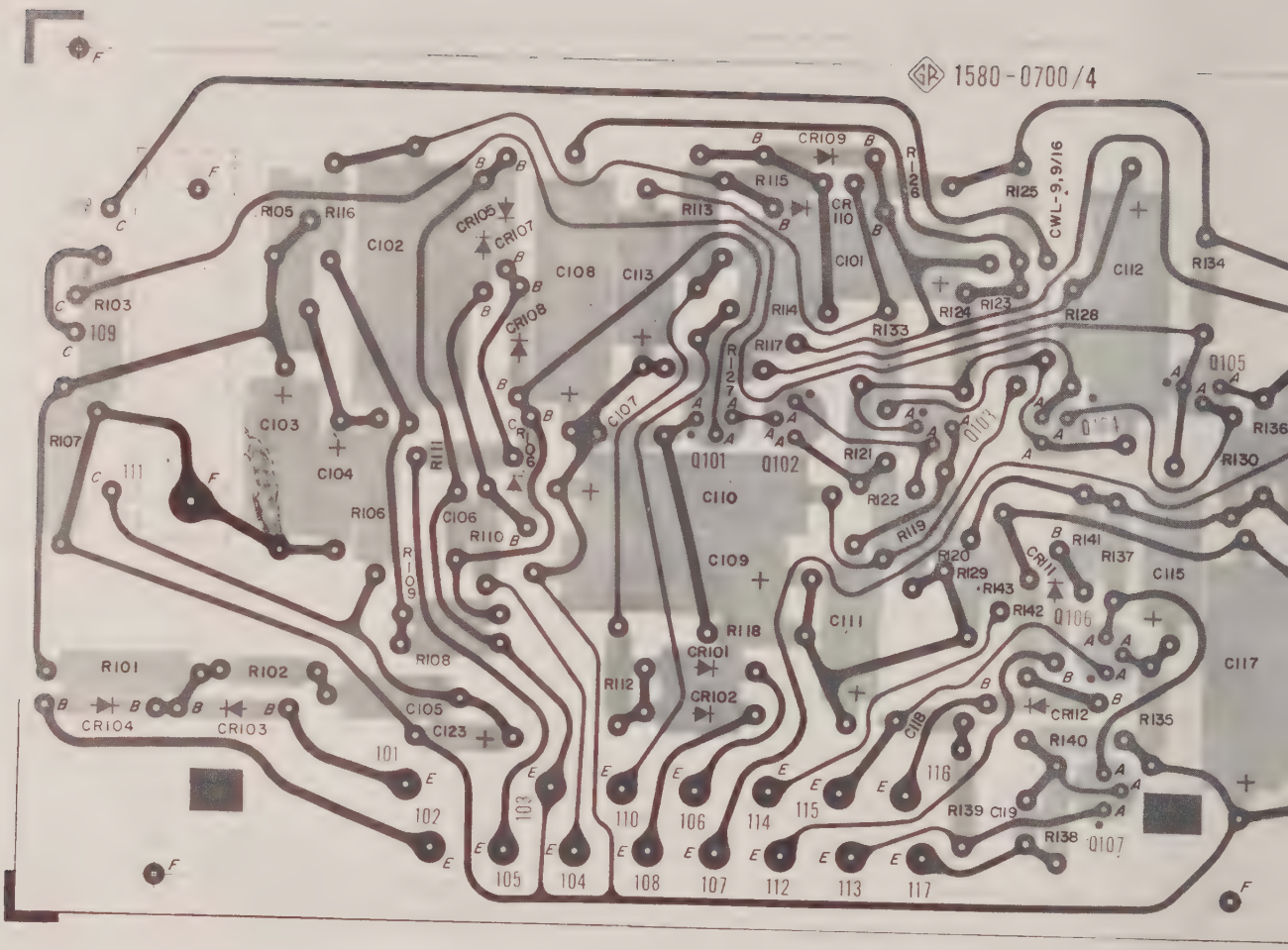



Figure 4-5. Etched board, Types 1581-A and 1582-A Regulators.
(Complete etched-board assembly is 1580-2701.)

NOTE: The number appearing on the foil side is not the part number.

# PARTS LIST

## TYPES 1581 AND 1582 VARIAC AUTOMATIC VOLTAGE REGULATOR
## PARTS LIST FOR CONTROL UNIT

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| | **CAPACITORS** | |
| C101 | Electrolytic, 10μF +100-10% 150V | 4450-3100 |
| C102 | Wax, 1μF ±10% 100V | 5010-3700 |
| C103 | Electrolytic, 15μF +100-10% 25V | 8420-3930 |
| C104 | Electrolytic, 3.3μF ±10% 35V | 8420-4000 |
| C105 | Plastic, .01μF ±10% 100V | 4860-7750 |
| C106 | Ceramic, .01μF +80-20% 500V | 4406-3109 |
| C107 | Ceramic, .01μF +80-20% 500V | 4406-3109 |
| C108 | Electrolytic, 60μF +100-10% 25V | 4450-2900 |
| C109 | Electrolytic, 60μF +100-10% 25V | 4450-2900 |
| C110 | Electrolytic, 200μF +100-10% 6V | 4450-2610 |
| C111 | Electrolytic, 10μF +100-10% 25V | 4450-3800 |
| C112 | Electrolytic, 100μF +100-10% 15V | 4450-2800 |
| C113 | Electrolytic, 15μF +100-10% 15V | 4450-3700 |
| C114 | Electrolytic, 10μF +100-10% 25V | 4450-3800 |
| C115 | Electrolytic, 50μF +100-10% 3V | 4450-5590 |
| C116 | Electrolytic, 60μF +100-10% 25V | 4450-2900 |
| C117 | Electrolytic, 60μF +100-10% 25V | 4450-2900 |
| C118 | Ceramic, .01μF +80-20% 500V | 4406-3109 |
| C119 | Ceramic, 470pF +10% 500V | 4404-1478 |
| C120 | Ceramic, 0.1μF +80-20% 50V | 4403-4100 |
| C121 | Ceramic, 0.1μF +80-20% 50V | 4403-4100 |
| C123 | Electrolytic, 1μF ±10% 35V | 4450-4301 |
| C124 | Ceramic, .01μF +80-20% 500V | 4406-3109 |
| C125 | Ceramic, .01μF +80-20% 500V | 4406-3109 |
| | **RESISTORS** | |
| R101 | Film, 549Ω +1% 1/2W | 6450-0549 |
| R102 | Carbon, 240kΩ ±5% 1/2W | 6100-4245 |
| R103 | Film, 20kΩ ±1% 1/2W | 6450-2200 |
| R104 | Potentiometer, 10kΩ ±10% | 6050-1800 |
| R105 | Potentiometer, 2.5kΩ ±10% | 6059-2259 |
| R106 | Film, 12.1kΩ ±1% 1/2W | 6450-2121 |
| R107 | Film, 2.15kΩ ±1% 1/2W | 6450-1215 |
| R108 | Carbon, 6.8kΩ ±5% 1/2W | 6100-2685 |
| R109 | Carbon, 11kΩ ±5% 1/2W | 6100-3115 |
| R110 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R111 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R112 | Carbon, 22Ω ±5% 1/2W | 6100-0225 |
| R113 | Carbon, 1.5kΩ ±5% 1W | 6110-2155 |
| R114 | Carbon, 6.2kΩ ±5% 1/2W | 6100-2625 |
| R115 | Carbon, 1.6kΩ ±5% 1/2W | 6100-2165 |
| R116 | Carbon, 33kΩ ±5% 1/2W | 6100-3335 |
| R117 | Carbon, 75Ω ±5% 1/2W | 6100-0755 |
| R118 | Carbon, 2MΩ ±5% 1/2W | 6100-5205 |
| R119 | Carbon, 22kΩ ±5% 1/2W | 6100-3225 |
| R120 | Carbon, 5.1kΩ ±5% 1/2W | 6100-2515 |
| R121 | Carbon, 15kΩ ±5% 1/2W | 6100-3155 |
| R122 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| R123 | Carbon, 24kΩ ±5% 1/2W | 6100-3245 |
| R124 | Carbon, 6.2kΩ ±5% 1/2W | 6100-2625 |
| R125 | Carbon, 1.1kΩ ±5% 1/2W | 6100-2115 |
| R126 | Carbon, 15kΩ ±5% 1/2W | 6100-3155 |
| R127 | Carbon, 470Ω ±5% 1/2W | 6100-1475 |
| R128 | Carbon, 1kΩ ±5% 1/2W | 6100-2105 |
| R129 | Carbon, 1.1kΩ ±5% 1/2W | 6100-2115 |
| R130 | Carbon, 20kΩ ±5% 1/2W | 6100-3205 |

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| | **RESISTORS (Cont.)** | |
| R131 | 0Ω | |
| R132 | Potentiometer, 10kΩ ±10% | 6050-1800 |
| R133 | Carbon, 10kΩ ±5% 1/2W | 6100-3105 |
| R134 | Carbon, 6.2kΩ ±5% 1/2W | 6100-2625 |
| R135 | Carbon, 1kΩ ±5% 1/2W | 6100-2105 |
| R136 | Carbon, 5.1kΩ ±5% 1/2W | 6100-2515 |
| R137 | Carbon, 3.3kΩ ±5% 1/2W | 6100-2335 |
| R138 | Carbon, 47kΩ ±5% 1/2W | 6100-3475 |
| R139 | Carbon, 470Ω ±5% 1/2W | 6100-1475 |
| R140 | Carbon, 1kΩ ±5% 1/2W | 6100-2105 |
| R141 | Carbon, 180Ω ±5% 1/2W | 6100-1185 |
| R142 | Carbon, 180Ω ±5% 1/2W | 6100-1185 |
| R143 | Carbon, 1.5kΩ ±5% 1/2W | 6100-2155 |
| | **DIODES AND RECTIFIERS** | |
| CR101 | Diode, 1N3253 | 6081-1001 |
| CR102 | Diode, 1N3253 | 6081-1001 |
| CR103 | Diode, 1N645 | 6082-1016 |
| CR104 | Diode, 1N645 | 6082-1016 |
| CR105 | Diode, 1N645 | 6082-1016 |
| CR106 | Diode, 1N645 | 6082-1016 |
| CR107 | Diode, 1N645 | 6082-1016 |
| CR108 | Diode, 1N645 | 6082-1016 |
| CR109 | Diode, 1N968A | 6083-1017 |
| CR110 | Diode, 1N935 | 6083-1026 |
| CR111 | Diode, 1N645 | 6082-1016 |
| CR112 | Diode, 1N645 | 6082-1016 |
| CR113 | Rectifier, 1N3492 | 6081-1005 |
| CR114 | Rectifier, 1N3492 | 6081-1005 |
| CR115 | Rectifier, 1N3492 | 6081-1005 |
| CR116 | Rectifier, 1N3492 | 6081-1005 |
| | **TRANSISTORS** | |
| Q101 | 2N2714 | 8210-1047 |
| Q102 | 2N2714 | 8210-1047 |
| Q103 | 2N1305 | 8210-1305 |
| Q104 | 2N1304 | 8210-1304 |
| Q105 | 2N1305 | 8210-1305 |
| Q106 | 2N1377 | 8210-1377 |
| Q107 | 2N1377 | 8210-1377 |
| Q108 | 2N1011 | 8210-1050 |
| Q109 | 2N1011 | 8210-1050 |
| | **MISCELLANEOUS** | |
| F101, 102 | Etched Circuit Assembly, complete | 1580-2701 |
| | Fuses, FUF1, 0.5 ampere | 5330-1000 |
| PL101 | Plug | 4220-4613 |
| S101 | Switch | 7910-1300 |
| T101 | Transformer, (For 115V and 230V) | 0745-4350 |
| T101 | Transformer, (For 460V) | 0745-4370 |
| T102 | Transformer, (For 115V and 230V) | 0345-4009 |
| T102 | Transformer, (For 460V) | 0345-4015 |
| T103 | Transformer | 0745-4360 |

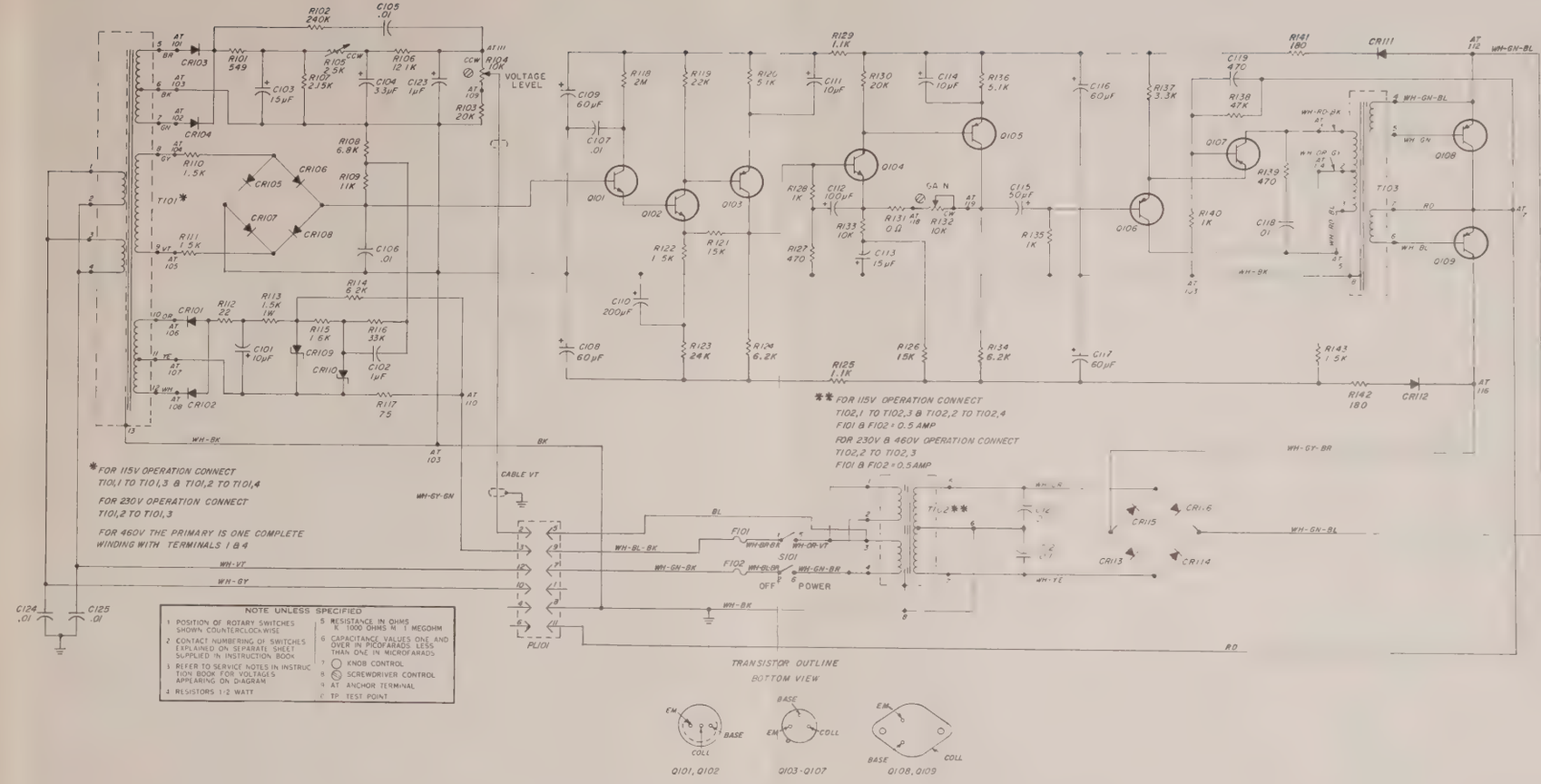

VOLTAGE LEVEL
* FOR 115V OPERATION CONNECT T101,1 TO T101,3 & T101,2 TO T101,4
FOR 230V OPERATION CONNECT T101,2 TO T101,3
FOR 460V THE PRIMARY IS ONE COMPLETE WINDING WITH TERMINALS 1 & 4
** FOR 115V OPERATION CONNECT T102,1 TO T102,3 & T102,2 TO T102,4 F101 & F102 = 0.5 AMP
FOR 230V & 460V OPERATION CONNECT T102,2 TO T102,3 F101 & F102 = 0.5 AMP
NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1-2 WATT
5 RESISTANCE IN OHMS K 1000 OHMS M 1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
TP TEST POINT
TRANSISTOR OUTLINE BOTTOM VIEW
Q101, Q102
Q103-Q107
Q108, Q109

Figure 4-6. Schematic diagram of control unit, Types 1581-A and 1582-A Regulators.

## PARTS LIST

### TYPE 1581 VARIAC AUTOMATIC VOLTAGE REGULATOR PARTS LIST FOR POWER CIRCUIT

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| C508 | Capacitor, Oil, 2μF ±10% 600V (Part of Transformer T502) (For 60-cycle motor) | |
| C508 | Capacitor, Oil 0.15μF ±10% 600V (Part of Transformer T502) (For 400-cycle motor) | |
| M0501 | Motor, 60-cycle (Part of Transformer T502) | MOD-3000 |
| M0501 | Motor, 400-cycle (Part of Transformer T502) | MOD-3002 |
| S0501 | Socket | 4230-0204 |
| T501 | Transformer | |
| | For 115V, 60 c/s, ± 10% range | 0565-4260 |
| | For 115V, 400 c/s, ± 10% range | 0565-4260 |
| | For 115V, 60 c/s, ± 20% range | 0565-4261 |
| | For 115V, 400 c/s, ± 20% range | 0565-4261 |
| | For 230V, 60 c/s, ± 10% range | 0565-4263 |
| | For 230V, 400 c/s, ± 10% range | 0565-4263 |
| | For 230V, 60 c/s, ± 20% range | 0565-4264 |
| | For 230V, 400 c/s, ± 20% range | 0565-4264 |
| | For 230V, 60 c/s, ± 5% range | 0565-4262 |
| | For 230V, 400 c/s, ± 5% range | 0565-4262 |
| T502 | Transformer | |
| | For 115V, 60-cycle motor | 3060-4720 |
| | For 115V, 400-cycle motor | 3060-4721 |
| | For 230V, 60-cycle motor | 3060-4730 |
| | For 230V, 400-cycle motor | 3060-4731 |

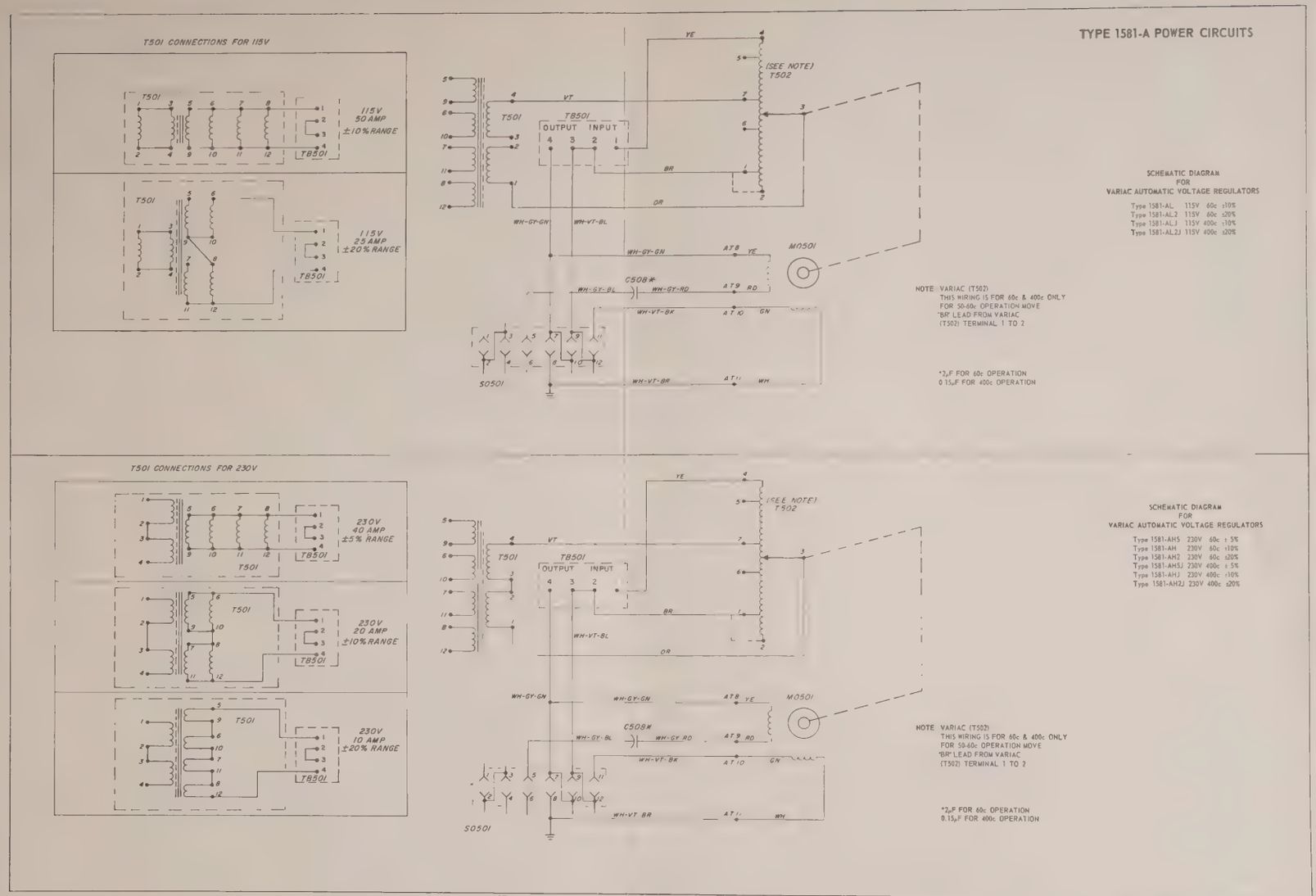

TYPE 1581-A POWER CIRCUITS
T501 CONNECTIONS FOR 115V
115V 50 AMP ±10% RANGE
115V 25 AMP ±20% RANGE
T501 CONNECTIONS FOR 230V
230V 40 AMP ±5% RANGE
230V 20 AMP ±10% RANGE
230V 10 AMP ±20% RANGE
(SEE NOTE) T502
T501
TB501
OUTPUT INPUT
M0501
S0501
C508*
SCHEMATIC DIAGRAM FOR VARIAC AUTOMATIC VOLTAGE REGULATORS
Type 1581-AL 115V 60c ±10%
Type 1581-AL2 115V 60c ±20%
Type 1581-ALJ 115V 400c ±10%
Type 1581-AL2J 115V 400c ±20%
NOTE: VARIAC (T502) THIS WIRING IS FOR 60c & 400c ONLY FOR 50-60c OPERATION MOVE "BR" LEAD FROM VARIAC (T502) TERMINAL 1 TO 2
*2μF FOR 60c OPERATION 0.15μF FOR 400c OPERATION
SCHEMATIC DIAGRAM FOR VARIAC AUTOMATIC VOLTAGE REGULATORS
Type 1581-AH5 230V 60c ± 5%
Type 1581-AH 230V 60c ±10%
Type 1581-AH2 230V 60c ±20%
Type 1581-AH5J 230V 400c ± 5%
Type 1581-AHJ 230V 400c ±10%
Type 1581-AH2J 230V 400c ±20%

Figure 4-7. Schematic diagram of power circuits, Type 1581-A Regulator.

## PARTS LIST

### TYPE 1582 VARIAC AUTOMATIC VOLTAGE REGULATOR PARTS LIST FOR POWER CIRCUIT

| REF. NO. | DESCRIPTION | PART NO. |
|---|---|---|
| C508 | Capacitor, Oil, 2μF ±10% 600V (Part of Transformer T502) (For 60-cycle motor) | |
| C508 | Capacitor, Oil, 0.15μF ±10% 600V (Part of Transformer T502) (For 400-cycle motor) | |
| M0501 | Motor, 60-cycle (Part of Transformer T502) | MOD-3001 |
| M0501 | Motor, 400-cycle (Part of Transformer T502) | MOD-3002 |
| S0501 | Socket | 4230-0204 |
| T501 | Transformer | |
| | For 115V, 60 c/s, ±10% range | 0765-4001 |
| | For 115V, 400 c/s, ±10% range | 0765-4001 |
| | For 115V, 60 c/s, ±20% range | 0765-4002 |
| | For 115V, 400 c/s, ±20% range | 0765-4002 |
| | For 230V, 60 c/s, ±10% range | 0765-4004 |
| | For 230V, 400 c/s, ±10% range | 0765-4004 |
| | For 230V, 60 c/s, ±20% range | 0765-4005 |
| | For 230V, 400 c/s, ±20% range | 0765-4005 |
| | For 230V, 60 c/s, ±5% range | 0765-4003 |
| | For 230V, 400 c/s, ±5% range | 0765-4003 |
| | For 460V, 60 c/s, ±10% range | 0765-4012 |
| | For 460V, 400 c/s, ±10% range | 0765-4012 |
| | For 460V, 60 c/s, ±20% range | 0765-4013 |
| | For 460V, 400 c/s, ±20% range | 0765-4013 |
| | For 460V, 60 c/s, ±5% range | 0765-4011 |
| | For 460V, 400 c/s, ±5% range | 0765-4011 |
| T502 | Transformer | |
| | For 115V, 60-cycle motor | 3038-4000 |
| | For 115V, 400-cycle motor | 3038-4001 |
| | For 230V, 60-cycle motor | 3038-4010 |
| | For 230V, 400-cycle motor | 3038-4011 |

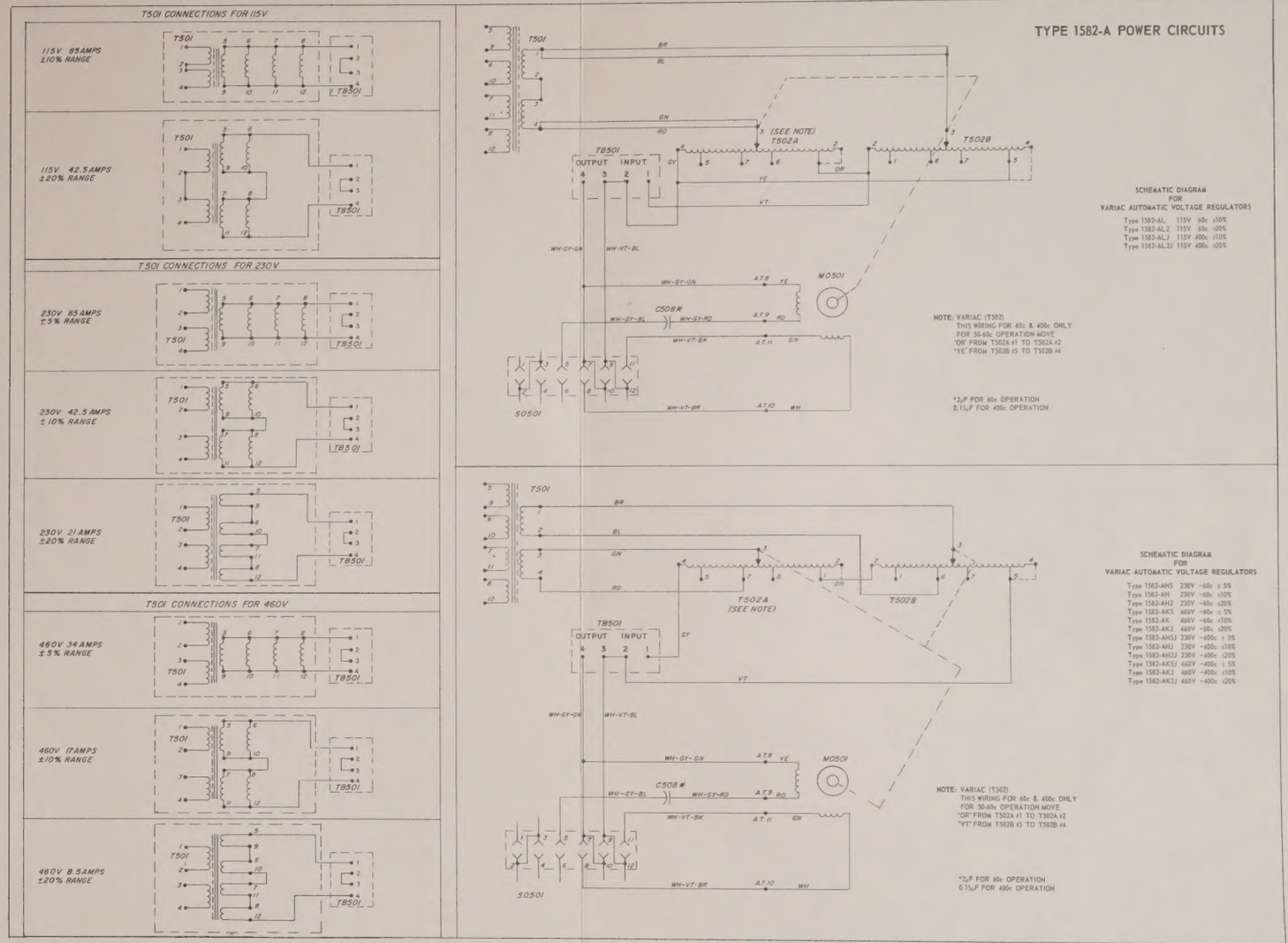

T501 CONNECTIONS FOR 115V
115V 85 AMPS ±10% RANGE
115V 42.5 AMPS ±20% RANGE
T501 CONNECTIONS FOR 230V
230V 85 AMPS ±5% RANGE
230V 42.5 AMPS ±10% RANGE
230V 21 AMPS ±20% RANGE
T501 CONNECTIONS FOR 460V
460V 34 AMPS ±5% RANGE
460V 17 AMPS ±10% RANGE
460V 8.5 AMPS ±20% RANGE
TYPE 1582-A POWER CIRCUITS
SCHEMATIC DIAGRAM FOR VARIAC AUTOMATIC VOLTAGE REGULATORS
Type 1582-AL 115V 60c ±10%
Type 1582-AL2 115V 60c ±20%
Type 1582-ALJ 115V 400c ±10%
Type 1582-AL2J 115V 400c ±20%
NOTE: VARIAC (T502)
THIS WIRING FOR 60c & 400c ONLY
FOR 50-60c OPERATION MOVE
'OR' FROM T502A #1 TO T502A #2
'YE' FROM T502B #5 TO T502B #4
*2μF FOR 60c OPERATION
0.15μF FOR 400c OPERATION
SCHEMATIC DIAGRAM FOR VARIAC AUTOMATIC VOLTAGE REGULATORS
Type 1582-AH5 230V ~60c ± 5%
Type 1582-AH 230V ~60c ±10%
Type 1582-AH2 230V ~60c ±20%
Type 1582-AK5 460V ~60c ± 5%
Type 1582-AK 460V ~60c ±10%
Type 1582-AK2 460V ~60c ±20%
Type 1582-AH5J 230V ~400c ± 5%
Type 1582-AHJ 230V ~400c ±10%
Type 1582-AH2J 230V ~400c ±20%
Type 1582-AK5J 460V ~400c ± 5%
Type 1582-AKJ 460V ~400c ±10%
Type 1582-AK2J 460V ~400c ±20%
NOTE: VARIAC (T502)
THIS WIRING FOR 60c & 400c ONLY
FOR 50-60c OPERATION MOVE
'OR' FROM T502A #1 TO T502A #2
'YT' FROM T502B #5 TO T502B #4
*2μF FOR 60c OPERATION
0.15μF FOR 400c OPERATION

Figure 4-8. Schematic diagram of power circuits, Type 1582-A Regulator.

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